ARMY AIR DEFENSE OPERATIONS

SUBCOURSE NO. AD0700

US Army Air Defense Artillery School
Fort Bliss, Texas 79916

Ten Credit Hours

GENERAL

This subcourse addresses the history of US Army AD. It presents the AD capabilities of our ADA weapon systems, their operations, and the organizations of those systems.

Lesson 1:	AD HISTORY AND THE AIR THREAT
TASK:	This lesson does not specifically relate to any enlisted or officer tasks, but provides general information on the history of ADA, the Soviet air threat, and US Army AD.
CONDITIONS:	Use only this lesson material to complete the examination.
STANDARDS:	You must attain a grade of 70 percent or more on the examination to receive credit for this subcourse.

Lesson 2:	CURRENT AD WEAPON SYSTEMS
TASK:	This lesson does not specifically relate to enlisted or officer tasks, but provides general information on current AD weapon systems.
CONDITIONS:	Use only this lesson material to complete the examination.
STANDARDS:	You must attain a grade of 70 percent or more on the examination to receive credit for this subcourse.

Lesson 3:	ADA OPERATIONS
TASK:	This lesson does not specifically relate to enlisted or officer tasks, but provides general information on the basic principles of employment prioritization and control of AD assets.
CONDITIONS:	Use only this lesson material to complete the examination.
STANDARDS:	You must attain a grade of 70 percent or more on the examination to receive credit for this subcourse.

Lesson 4:	ADA ORGANIZATIONS
TASK:	This lesson does not specifically relate to enlisted or officer tasks, but provides general information on the structure of US Army AD organizations.

CONDITIONS: Use only this lesson material to complete the examination.

STANDARDS: You must attain a grade of 70 percent or more on the examination to receive credit for this subcourse.

Unless otherwise stated, the masculine gender applies to both men and women.

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LESSON 1

AD HISTORY AND THE AIR THREAT

TASK

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CONDITIONS

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STANDARDS

You must attain a grade of 70 percent or more on the examination to receive credit for this subcourse.

REFERENCES

The following references are sources for additional information. You do not need them to complete this lesson.

FM 44-1
FM 44-2
FM 44-3
FM 44-15
FM 44-15-1
FM 44-90
FM 44-90-1

Learning Event 1:
MISSION OF AD

The AD Mission Defined

The mission of AD, according to the cartoon in Figure 1, may have been to nullify or reduce the effectiveness of airborne predators; thereby supporting the primary tribal functions of conducting prompt and sustained land operations.

FIGURE 1. THE BEGINNING.

As airborne predators have become more complex, so have the AD weapons required for their engagement. However, the basic mission of AD and its primary objectives have changed only slightly--to nullify or reduce the effectiveness of attack or surveillance by hostile aircraft or missiles after they are airborne--thereby supporting the primary Army functions of conducting prompt and sustained land warfare operations.

But more directly, AD must seek as its primary objective the limitation of the effectiveness of the enemy offensive air effort to a level permitting freedom of action to friendly forces of all types. Specifically, the objective is to protect US forces in the field and to ensure them freedom of maneuver.

Necessity

Unless you are prepared to meet high-performance threat aircraft with your supply of sharp rocks, a working knowledge of AD is critical to your survival and to that of others of the unit to which you are assigned.

Learning Event 2:
HISTORY OF AD

Pre-World War I

During the American Civil War you might have been able to meet the air threat with a barrage of well-thrown rocks. The Confederates, however, chose a rifled 6-pound cannon to counter the Union's observation balloon, Intrepid (Figure 2), in August 1861. Although no hits were scored, the balloon was hauled down and neither side thereafter pursued any large-scale military use of that type of aerial threat.

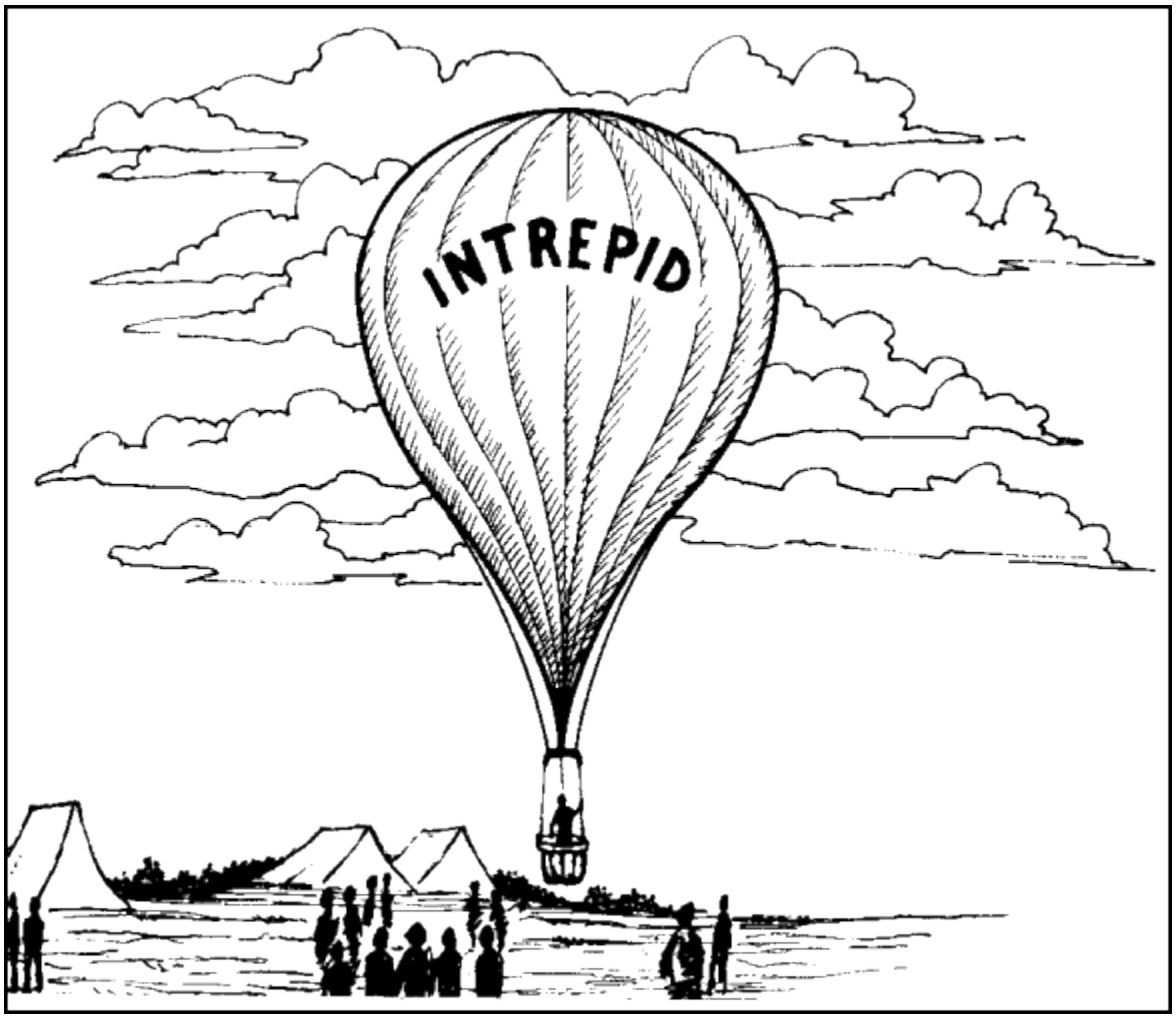


FIGURE 2. THE INTREPID.

During the Franco-Prussian War of 1870, balloons were used not only as a means of observation, but also for movements in and out of besieged Paris. This led to the development of the Krupp balloon gun, a 75-millimeter weapon which fired a 12-pound shell to an altitude of about 20,000 feet.

World War I

World War I witnessed the birth of a new method of warfare--that of attack from the air. This, in turn, required those on the receiving end of such attack to combat the new threat with airplanes and antiaircraft guns. The cycle continued, and attackers had to change tactics and techniques to offset the defense.

By today's standards, World War I AD materiel and operations were primitive in nature, but they set patterns and isolated problems which remain with us today. Thus, the First Great War is more noteworthy for establishing trends in weapons and tactics than for producing statistics as to bombs dropped and planes destroyed.

The 1919-1939 Period

The period between World War I and World War II was one of development in air offensive and defensive weapons. The United States, Great Britain, Germany, and Japan (all to be major air war combatants in WW II) made tremendous advances in aircraft design and performance, but only limited improvements in aircraft tactics. Thus, there were no startling developments in the military use of aircraft over those introduced in World War I.

In general, air offensive forces in 1939 enjoyed an advantage over defensive forces. This situation resulted primarily from two factors. First, Germany and Japan had decided upon offensive military operations, to include air operations, as national strategy. Logically, priority of weapon development was given to bombers and their tactical use. In both countries, little effort was devoted to AD weapon systems or AD operations. Second, the airplane had enjoyed commercial and military application. Private industry had contributed immeasurably to improved aircraft performance and capabilities in an effort to benefit commercially in competitive business. By contrast, antiaircraft guns and related equipment had military application only. Development usually resulted slowly from stated military requirements and from availability of military funds for such purposes.

The War in Europe

The United States entered World War II with basically the same weapons that we had at the end of World War I. It was not long, however, before American air defenders realized the need for better antiaircraft equipment to combat the vastly improved air threat.

The British met the WW II air threat with new radar and electronic IFF equipment. The use of that equipment, beginning with the Battle of Britain, provided a distinct advantage over the German Luftwaffe.

During the early part of the war, Germany developed and used ballistic missiles and cruise-guided missiles. They also developed the first jet fighter aircraft and the V-2 rocket, neither of which were employed by Germany in time to significantly affect the outcome of the war.

The War in the Pacific

Although the evolution of AD in the Pacific was similar to that in Europe, there were several unique lessons learned. The early American disasters of Pearl Harbor and the Philippines emphasized the importance of adequate early warning, aircraft identification, uniform command and control

procedures, and close coordination between all AD capable forces. The eventual defeat of the Japanese Empire emphasizes the importance of AD to a force not having air supremacy.

While adequate early warning and aircraft identification procedures might not have prevented the Japanese attack on Hawaii, the fact that an American radar unit detected the initial waves of Japanese aircraft and mistakenly dismissed them as a friendly flight of American bombers, contributed greatly to subsequent damage to the Pacific Fleet and to the island-based Army Air Corps.

Even after hostilities were initiated, a lack of early warning and passive AD measures in the Philippines caused the destruction of over one-half of the American Air Corps located in the Far East. Perhaps the most important lesson learned from these early defeats was that an effective AD organization must be available, trained, and ready to fight before it is needed--not after.

In analyzing the relative balance between the offense and defense throughout the Pacific, many factors should be considered. The Japanese had invested heavily before the war in developing superior offensive forces with which they expected to overwhelm the limited forces that opposed them; however, they failed to prepare for, or visualize, the requirements for strong defensive forces.

Japanese antiaircraft general officers interrogated at the end of the war expressed the belief that the inadequacy of their AD was one of the chief factors contributing to their early defeat. This belief is supported by a study of the losses that Japanese AD inflicted on American bombers. In the Pacific, American heavy bombers suffered a total loss due to known hostile AD action of less than 0.5 percent.

Analysis

The early part of the war saw each adversary testing the other's capabilities. The Germans were convinced that tactical air warfare, which had been successful in the conquest of continental Europe, would also provide adequate AD support of the war. AD was recognized but not centrally planned or coordinated. The United States and the United Kingdom both adhered to the concept of strategic air operations by heavy bombers in addition to tactical operations by lighter aircraft.

The ultimate strategic use of air power by the United States against the Japanese Empire, resulting in the early termination of that conflict, would change the primary role of AD for decades to come.

Postwar Strategic Defense

In the late 1940s and early 1950s, the possibility of a Soviet-manned bomber attack against the United States emerged. This brought about a resurgence in AD activity.

The threat was perceived to be one or more manned bombers carrying nuclear weapons and flying at extremely high altitudes. This prompted the US to eliminate heavy AA gun systems in favor of more effective AD missile systems.

When nuclear ICBM capabilities increased, the manned bomber threat against CONUS decreased. AD research and development soared into the antimissile arena. The projected cost of an arms race contributed to the decisions by both the United States and the Soviet Union to enter into strategic arms limitations agreements.

AD in Korea and Vietnam

The US had complete air superiority during both the Korean and Vietnamese conflicts. This meant that ADA units did not have many occasions to engage aerial targets. The role of antiaircraft weapons became primarily one of ground fire support.

The principal AD lesson learned from the Vietnamese conflict concerned the losses suffered by Air Force and Navy aircraft and Army helicopters from enemy SHORAD and small arms weapons.

Learning Event 3:
THE AIR THREAT

Soviet Aviation

Soviet tactical aviation has been the focus of comprehensive modernization and reorganization programs emphasizing offensive capabilities. Changes over the last five years in the areas of equipment, training, tactics, and organization have not occurred spontaneously. They are the results of careful, long-range planning to increase tactical aviation capabilities against NATO. Since 1978, the Soviets have introduced two new fighters and three new versions of reconnaissance and ground attack aircraft. These aircraft have increased ranges, improved avionics, better altitude and all-weather capabilities than previous Soviet models.

Training and Tactics. There have also been significant changes in training and tactics that are less visible than equipment improvements, but which have a potentially far greater effect on tactical aviation effectiveness. Soviet doctrine places great emphasis on achieving air superiority from the outset. To implement this doctrine, the Soviets have recently made significant changes in their combat air tactics and training programs. Pilot independence and initiative are now stressed, a significant departure from previous procedures requiring positive ground control of air operations. Continued technological upgrading of equipment and increasing proficiency in combat employment of that equipment have greatly increased Soviet aviation capabilities to strike the NATO rear area.

Improved tactics and training are aimed at maximizing performance of a new generation of Soviet aircraft that will have better penetration capabilities. Also, recent major reorganizations of the command and control structure for Soviet air and AD forces have greatly improved Soviet air combat capabilities. Their new structure now provides the Soviets with a peacetime organization that closely approximates their anticipated wartime structure for the employment of air power. This will allow a more rapid transition to a wartime posture and will enhance operational flexibility and coordination through centralized control of air assets at front and theater levels.

The Soviets and Warsaw Pact nations will continue to have an aircraft quantity advantage over NATO and are rapidly closing the qualitative capabilities gap. They have, and must be expected to use, these capabilities to attack our maneuver forces and their supporting elements, as well as striking corps and theater targets to destroy NATO deep strike assets.

The Nature of the Air Battle

In any future conflict the air battle will be characterized by the following:

- Sudden attack by a large number of aircraft on multiple targets, with many of the aircraft using a variety of terrain following techniques.
- Surprise; no one is ever fully prepared for an air attack or its shock effect.
- Delivery of many types of munitions, to include gravity bombs, rockets, PGMs, ARMs, and projectiles.
- An airspace congested by many users including friendly air, enemy air, field artillery projectiles and missiles, and ADA on both sides, to mention a few.
- Use of short-range ballistic missiles by the threat to attack and destroy friendly "deep strike" assets.
- An urgency for rapid reaction response. Little time will be available for deliberation; action must be automatic.
- Dense electromagnetic conflict.

Mission Types

Soviet forces recognize that part of their air support is initially required to obtain local air superiority. Fighter units of the air army have the dual mission of providing AD and CAS for their ground forces. Attack and bomber units are used to engage targets beyond the range of artillery and to reinforce artillery fires on selected targets and targets of opportunity. A combined bombardment by bombers and ground attack aircraft is coordinated with artillery preparatory fires. After the ground attack has begun, tactical air will provide CAS for ground elements in contact. Priority tasks for enemy tactical air are the destruction or neutralization of hostile nuclear delivery means and other targets beyond artillery range.

Ground Attack. Soviet forces consider air strikes an extension of field artillery. They place great emphasis on tactical air support of ground operations. Attacks are made against preplanned targets to neutralize support and reserves within the tactical operational area. Soviet air forces usually do not use high-performance aircraft to provide CAS along the line of contact where artillery can be employed. Armed helicopters are the primary air threat along the forward line of troops.

Bombing Missions. The primary responsibility of Soviet bombers is to maintain a strategic force capable of conducting strikes against military and industrial targets. Although ballistic missiles have an increased role in destruction of deep targets, the Soviets will retain a sizeable bomber force for many years to come. Bombers have certain advantages over ballistic missiles. Bombers are used for non-nuclear as well as nuclear warfare, and can seek out and strike small and mobile targets. Additionally, they can be recalled or retargeted after launch. They can also conduct poststrike reconnaissance and have a restrike capability.

Aerial Reconnaissance. Tactical aerial reconnaissance is a method of gathering intelligence concerning the enemy. It employs airborne collection devices ranging from aircrew eyes to the most advanced sensory devices. The Soviets will use reconnaissance aircraft equipped with sensors capable of monitoring US operations in daylight, darkness, and inclement weather. Reconnaissance aircraft can operate singly or in pairs.

ECM. Soviet aviation has several organic support squadrons with aircraft equipped to conduct ECM missions. These units can conduct ECM against enemy radar and electronic guidance and communications systems. The most common air ECM operations are spot or barrage jamming and dispensing chaff. ECM are directed against enemy AD early warning and fire control radars. Soviet bombing operations will be protected or camouflaged by aircraft using ECM in either a standoff or escort role. Jamming equipment, with an effective range of up to 200 kilometers and covering frequencies of NATO AD radars, is installed in these ECM aircraft. They may also eject chaff to achieve deception and camouflage. Other individual aircraft may carry self-screening jammers and chaff dispensers.

Tactical Airlift. The Soviets consider tactical airlift operations critical in both the conventional and nuclear areas. Tactical airlift operations include logistics operations, airborne drops, and assault landings.

Air Superiority. Fighter aircraft are normally given the mission of destroying enemy aircraft on approaches, flanks, and beyond the maximum range of the ground-based AD systems within a zone. For example, the integration of fighter and SAM systems within a zone is by geographical area, altitude layering, time separation, or by specific target allocation within a particular area. It should be understood that while aircraft may be hostile, not all aircraft are priority threats to AD. A fighter interceptor poses little or no threat to a defended asset when compared to CAS aircraft.

Heliborne Assaults. Soviet forces have placed increasing emphasis on air assault operations in recent years. The mobility of helicopters allows Soviet commanders--

- To assist attacking forces by rapidly surmounting obstacles and large areas of NBC contamination.
- To prevent enemy forces from closing gaps created by nuclear strikes.
- To seize and hold important objectives in the rear operations area until the arrival of advancing troops.
- To conduct raids to destroy control points, radar posts, and signal centers.
- To assist maneuver units by providing a highly mobile antitank capability.

Soviet doctrine stresses maintaining the momentum of the attack. Heavy use of air assault missions is one way to do this. Their leadership believes that air assault missions are especially useful after a nuclear strike. Using this type of assault as soon as possible after a nuclear strike maximizes the gains made from the strike and minimizes the risk to air assault forces. Tactical air support, including assault helicopters, is often used to create a fly-through zone in enemy lines. Tactical air support generally continues until the air assault forces have landed and deployed.

In the past, Soviet forces have used helicopters to transport small numbers of specially trained airborne troops on air assault missions. Recently, however, emphasis has been placed on using motorized rifle battalions for these missions. Soviet leadership believes that these forces can be used effectively with a minimum of training. The threat presented by a motorized rifle battalion being airlifted behind our lines should not be underestimated.

Airborne Assaults. Airborne assaults are conducted with aircraft from military air transport forces. The mission of airborne forces is strategic, operational, or tactical.

Strategic missions are usually conducted in division strength. The purpose of this type of mission is to establish a new battle front within a theater of operations. Operational missions are conducted in support of armies or fronts. Units conducting these operations are usually of regimental size or smaller and are dropped from 200 to 1,000 kilometers in the rear. Tactical missions are conducted up to 200 kilometers in the rear. Normal objectives are seizing bridgeheads and critical road or rail junctions, destroying airfields, and disrupting rear areas. In a nuclear environment, tactical missions are most often used to exploit a nuclear strike.

Although airborne operations can be conducted at almost any time, Soviet forces generally conduct them at night. Airborne drops are generally preceded by an increase in reconnaissance of the drop area. Reconnaissance can be conducted by air, clandestine agents, long-range patrols, or airdropped reconnaissance teams.

Recently, Soviet emphasis on tactical airborne missions has decreased. Helicopter assaults are taking their place; however, airborne forces will still be used for operational and strategic missions.

Learning Event 4:
SOVIET AIRCRAFT AND CAPABILITIES

Soviet forces have been particularly effective in integrating older aircraft and newer, more modern aircraft into a formidable fighting force. These aircraft can be classified by the role for which they are used or by their type. All data presented are representative of the operational use of these aircraft rather than maximum design capabilities. Additional information on Soviet aircraft is in FM 44-1, Appendix D, and in FM 44-30.

Fixed-Wing Aircraft

The primary air threat facing our forces, and the one for which the Patriot system was designed to counter, is the fixed-wing threat. These aircraft operate in all areas over the battlefield and make up the vast majority of Soviet air forces.

Bombers. Medium bombers (Figure 3) will be used during the first phase of the air battle to strike targets critical to the theater in conducting and sustaining war efforts. These targets include air bases, nuclear storage sites, and military and industrial complexes. Medium bombers likely to be encountered are the Tu-16 Badger, Tu-22 Blinder, and the Tu-22M Backfire. These aircraft pose a unique threat to NATO units. Because of their extended range, they can be used in "end-around" tactics to attack NATO rear areas from the flanks and rear.

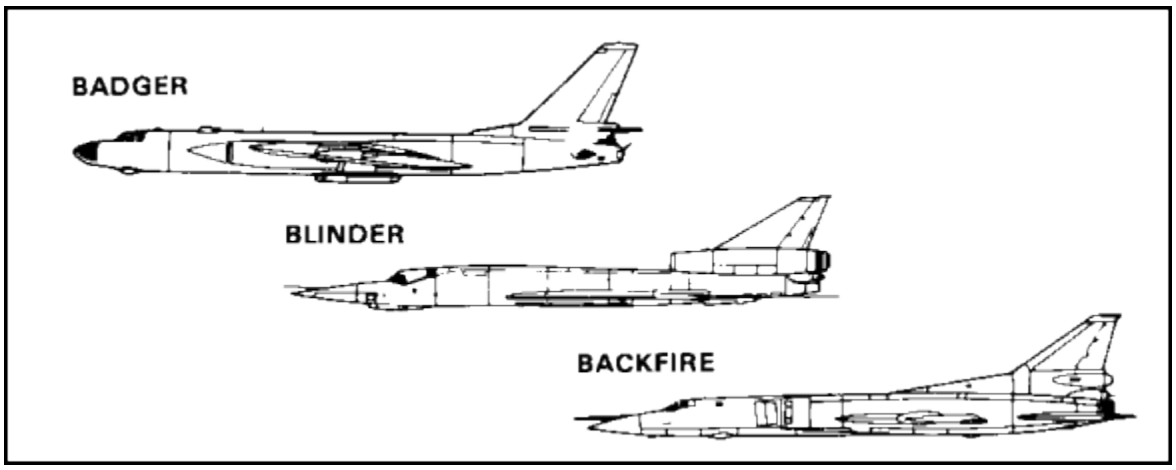


FIGURE 3. THREAT MEDIUM BOMBERS.

Fighter-Bombers. The early MiG-series aircraft (MiG-15, 17, 19, and 21) were all designed primarily as interceptors for use in the counterair role. Early MiGs could carry only two bombs or rocket pods on wing pylons normally used to carry external fuel pods. Because of this restricted ordnance carrying capability, their ability to attack ground targets was limited. Newer models of these aircraft are significantly improved in their ability to attack ground targets. The Su-17 Fitter C and D and the export variant Su-20 Fitter are typical of these improved, older generation aircraft. Two newer aircraft, in particular, have greatly increased the ground attack capability of Soviet forces. The MiG-27 Flogger D is designed specifically for ground attack. It is capable of carrying most new ordnance currently under development. To supplement this ground attack capability, the Su-24 Fencer has become operational. The Fencer is a deep penetration strike aircraft believed equivalent to our FB-111. Using an improved terrain avoidance radar, it may be able to underfly friendly radar defenses while conducting deep penetrations. Additionally, a new ground support fighter, the Su-25 Frogfoot, is designed to fly high-performance missions and is capable of carrying a wide variety of munitions (Figure 4).

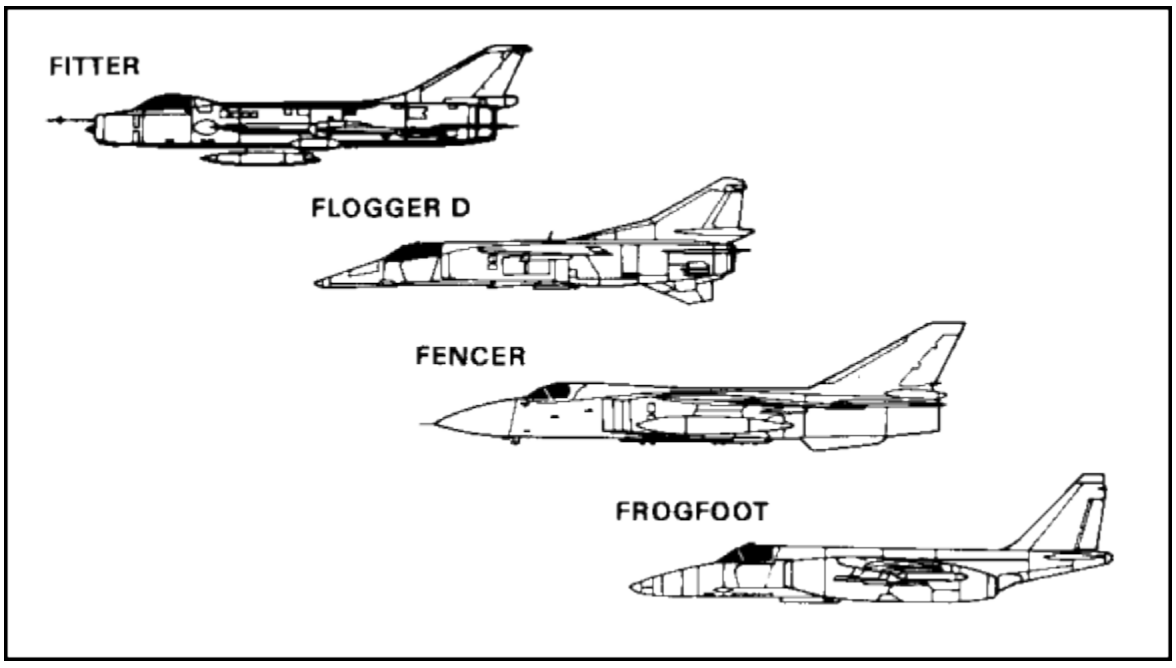


FIGURE 4. THREAT FIGHTER-BOMBERS.

Fighters. Despite the fact that fighters are defensive in nature, Patriot units will encounter fighters escorting strike aircraft penetrating friendly air defenses. The Soviets are also modernizing their forces of fighters. The early MiG- and Su-series aircraft have been improved in their air-to-air role. The second generation fighter currently in service is the MiG-23 Flogger B. It also has a secondary ground attack capability greater than the Fishbed or Fitter.

Reconnaissance Aircraft. Tactical aerial reconnaissance is one method of gathering intelligence concerning the enemy. The Soviets use reconnaissance aircraft (Figure 5) equipped with photographic and electronic sensors. This equipment is capable of detecting, locating, and monitoring US operations in daylight, darkness, and inclement weather. Reconnaissance aircraft can operate singly, but probably will operate jointly with ground attack aircraft. Soviet aircraft used most often for reconnaissance today are the Fitter, Fishbed, Flogger, and Foxbat.

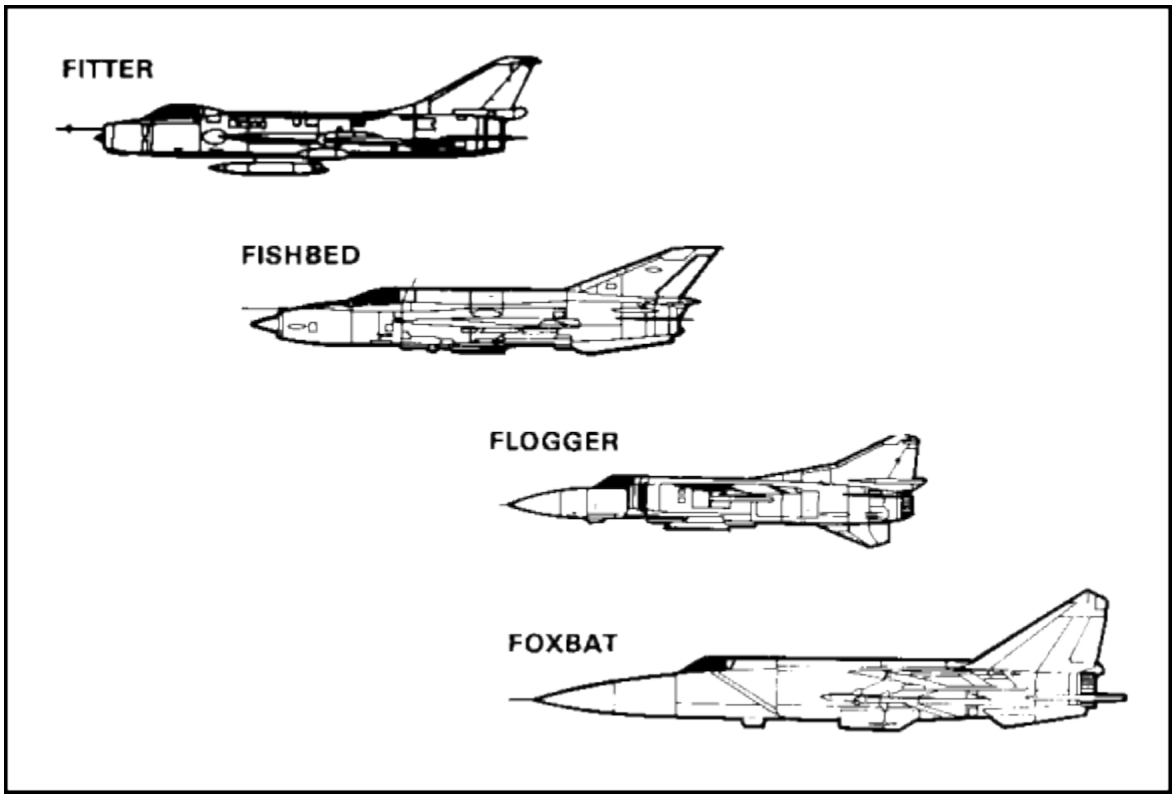


FIGURE 5. THREAT FIGHTERS AND RECONNAISSANCE AIRCRAFT.

ECM Support Aircraft

Generally, there are two roles for ECM support aircraft involved in support of offensive air operations. These two roles are SOJs and ESJs. These aircraft serve as airborne platforms for electronic jamming equipment, which is primarily directed against radar but may also be directed against communications.

The Soviets have modified transports, fighters, bombers, and helicopters to provide both standoff and escort jamming of enemy radars and communications equipment by using chaff and electronic jammers. Cub, Coot, and Badger aircraft were extensively modified to give these aircraft primary roles of standoff jamming while remaining outside the range of our HIMAD and defensive fighter aircraft.

Other Russian bombers and fighters also had ECM equipment installed to provide self-defense escort jamming on missions across the FEBA. The Brewer and the Mi-4 Hound helicopter were modified to provide jamming of enemy communications in the forward area in support of ground operations (Figure 6).

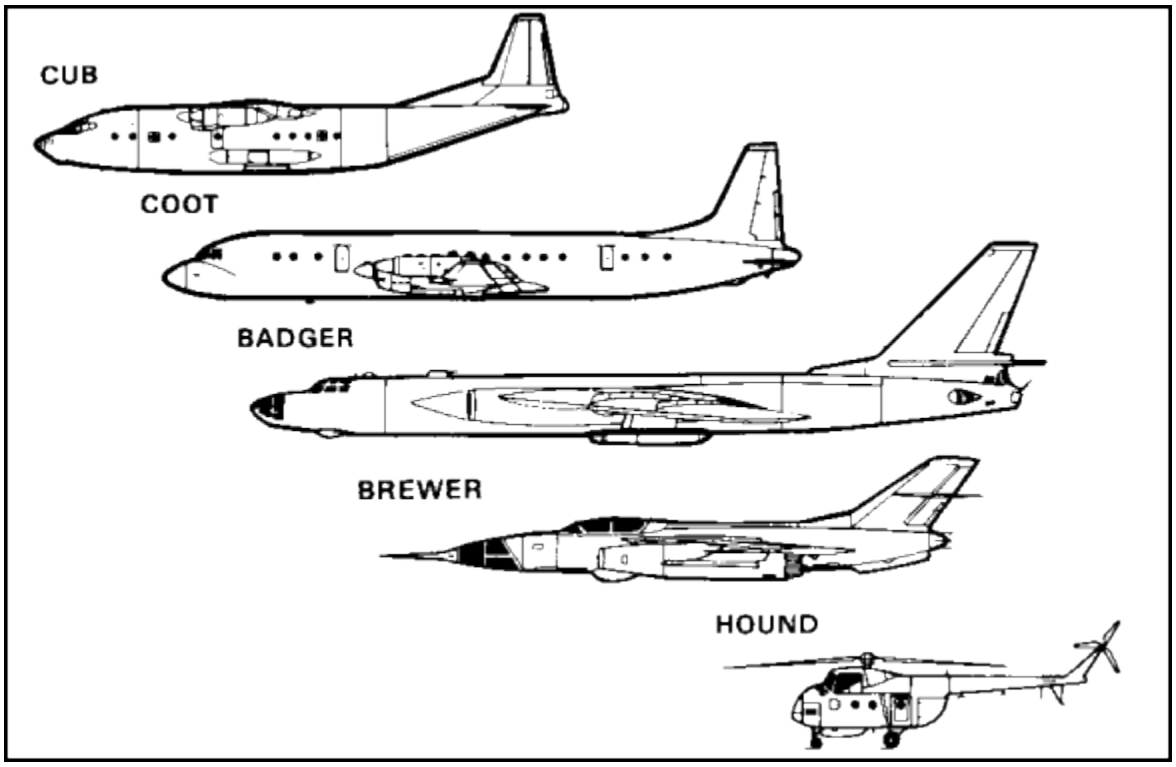


FIGURE 6. THREAT ECM SUPPORT AIRCRAFT.

Drone Aircraft

Drones are remotely piloted aircraft. They receive guidance from accompanying manned aircraft, ground control stations, or on-board, programmable navigation systems.

Drones are classified as either RRA or true drones. They are obsolete, retired fighter or reconnaissance aircraft withdrawn from frontline duty, such as the Yak-25 Mandrake and the MiG-19 Farmer. The Soviets have used both of these aircraft as SAM target drones for years. True drones are those designed and built as pilotless aircraft, such the LA17.

Drones may be used in the initial stages of air operations against NATO and may continue to be used until stocks are depleted. Both RRA and true drones can deliver a wide variety of ordnance. Additionally, drones can be used effectively as reconnaissance platforms.

The most significant advantage of drones is the elimination of pilot loss. An especially effective use of this advantage is to reconnoiter NBC contaminated areas. On the other hand, the lack of on-board human control limits the drone's maneuver capabilities. Other uses of drones are to reconnoiter fire unit positions and force HIMAD missile expenditure.

Rotary-Wing Aircraft

Helicopters have some distinct advantages over fixed-wing aircraft which enable them to be deployed in large numbers in forward areas. They do not require large airfields or costly runways from which to operate. They are suitable for conducting reconnaissance of the enemy's forward forces. They are highly mobile and can fly in weather that grounds fixed-wing aircraft. Helicopters can carry a wide variety of weapons including cannons, machine guns, ATGMs, free-flight rockets, and grenade launchers. They can also be used as EW platforms and to transport small, light units for air assault operations.

Attack Helicopters. The Soviets have the most heavily armed helicopters in the world today. They will employ them in the CFA, in the MBA, and in air assaults against rear area targets. The attack helicopter achieves maximum utility in a war of movement when employed in ambush or assault actions.

Using speed, mobility, surprise, and an impressive array of weapons, it can harass, delay, and destroy advancing columns and armor thrusts.

A new version of the Mi-8 Hip, called Hip E, has been introduced as being equipped with "the heaviest firepower seen on any helicopter in the world." Rocket and missile launching racks are now included on most Mi-8 Hip helicopters. The Soviets have fielded a new attack helicopter which is a dedicated gunship. This new aircraft is the Mi-28 Havoc. The Havoc carries no contingent of troops, but it is a formidable antitank weapon system capable of engaging other helicopters in air-to-air combat (Figure 7).

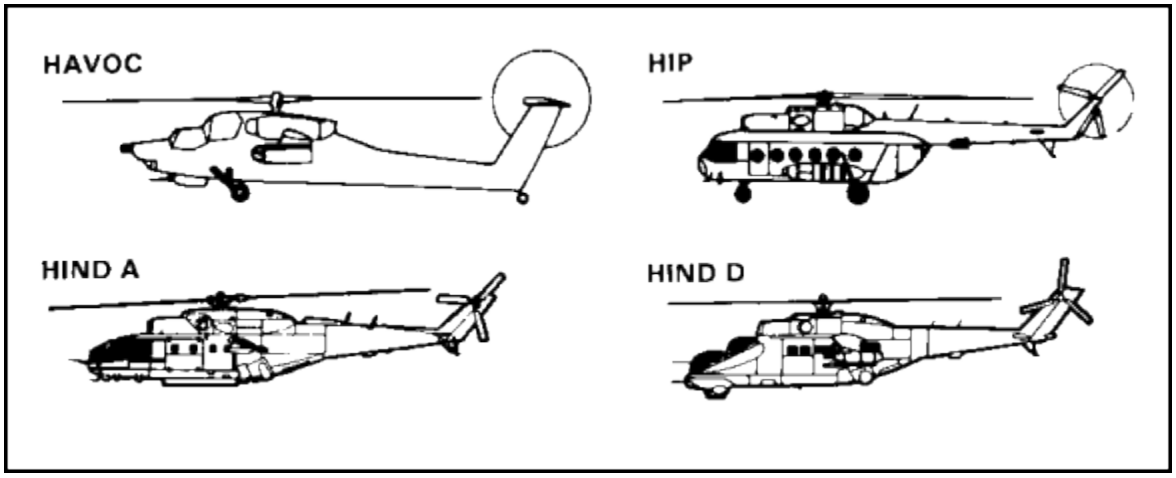


FIGURE 7. THREAT ATTACK HELICOPTERS.

ECM Helicopters. These aircraft operate to reduce the effectiveness of our communications. Specifically, the Mi-4 Hound C is designed as an ECM emitter of noise and chaff.

Utility Helicopters. The Mi-8 Hip is the main utility helicopter for Soviet forces and is replacing the Mi-4 Hound as the standard troop carrier for air assault operations.

Other helicopters which may be targets for ADA systems are the Mi-2 Hoplite which will act as a spotting aircraft for attack helicopters and the Mi-6 Hook. Helicopters may be targets for the Patriot

system when deep airmobile assaults are conducted or when helicopters conduct deep reconnaissance missions.

Learning Event 5:
SOVIET MUNITIONS AND ATTACK TECHNIQUES

Threat Munitions

The Soviets have a full spectrum of munitions capable of being airdropped and which are nearly as effective as those of our own Air Force. A new series of advanced munitions is in development and is expected to be deployed during Patriot fielding in NATO.

Bombs. Freefall bombs have been in the Soviet inventory for years. Guided bombs, similar to those developed by the NATO forces, are new additions to their ordnance inventory. Equipped with these new munitions, a single aircraft can now destroy a target that only a few years ago would have required attacks by large formations. Bombs may have HE, chemical, or nuclear warheads.

CBUs. A CBU consists of many small bomblets in one package. These can be carried in large numbers on any aircraft. CBUs are dropped at high speeds and low altitudes to cover a wide area, such as Hawk or Patriot unit positions.

Rockets. Rockets are loaded into pods or clusters which allow for a high rate of fire. These rockets are ballistic and are normally used against soft targets.

Napalm. Napalm is a jellied fuel mixture which is used against virtually all types of targets. The fuel mixture ignites on impact, burns the target, and forces personnel out of vehicles and shelters.

Cannons. In addition to employing specialized munitions, Soviet aircraft are equipped with cannons for use in strafing targets. Normally, these cannons are 23- or 30-millimeter guns. Fighters also carry cannons for self-defense.

ASMs. To improve capabilities against point targets, such as bridges and radar sites, the Soviets have deployed new ASMs with improved guidance systems. These ASMs are either command-guided, passive-homing, or active-homing missiles. Command-guided ASMs are flown into the target by the pilot or EW officer in the launching aircraft. The controller must see the target or have a remote TV pickup in the missile. Active homing is characterized by having an electromagnetic transmitter in the missile which illuminates the target. The missile then homes on the reflected energy. In passive homing, the missile homes on the target's own emissions, or on reflected energy when the target is illuminated from a source other than the missile.

Some of the earlier version ASMs are nearly the size of small aircraft and can be launched only from medium and heavy bombers. Tactical ASMs are delivered by fighter-bomber aircraft and represent the greatest threat in the tactical operations area. To radars, an especially dangerous type of ASM is the ARM which passively homes in on the targeted radar's emissions. These ARMs may be carried by bombers or fighter-bombers. Some can be launched outside the lethal kill envelope of Patriot, reducing the danger to the launching aircraft. ASMs may carry HE, nuclear, or chemical warheads.

Attack Techniques

High-performance, fixed-wing aircraft rely on speed and ECM for surprise and survival. Fixed-wing aircraft can attack ground targets in a variety of ways. The actual attack techniques depend on the type of target, aircraft, ordnance available, terrain, and weather. These techniques include--

- Gravity drop-bombing.
- Dive-bombing.
- Toss-bombing.
- Standoff.
- Pop-up.
- Lay-down.

The attack variations illustration (Figure 8) shows examples of attack techniques, ordnance, and targets.

ATTACK TECHNIQUE	ORDNANCE	WEAPON RELEASE HEIGHT (Meters)	AIRCRAFT SPEED (Meters per Second)	ORDNANCE RELEASE DISTANCE (Meters)	TARGET
POP-UP	BOMBS	810	230	1,110	ARMOR CONCENTRATIONS
GRAVITY DROP-BOMBING	BOMBS	2,000	300	3,000	LOGISTICS COMPLEXES
LAY-DOWN	CBU	500	230	1,200	VEHICLES, PERSONNEL IN OPEN
LAY-DOWN	NAPALM	60	260	900	ALL EXCEPT HEAVY STRUCTURES
TOSS-BOMBING	BOMBS	1,500	240	3,200	LOGISTICS COMPLEXES, HEADQUARTERS
DIVE-BOMBING	ROCKETS/ BOMBS	475	230	800	HEADQUARTERS, VEHICLES
STANDOFF	ASM	100	250	10,000	HIMAD BATTERY
STANDOFF	ASM	5,000	200	70,000	HEADQUARTERS COMPLEXES
POP-UP	CANNONS	475	130	800	VEHICLES, PERSONNEL IN OPEN

FIGURE 8. ATTACK VARIATIONS.

Gravity Drop-Bombing. Aircraft using gravity drop-bombing approach a predetermined drop-point. The ordnance is then delivered by free-fall gravity drop. The ordnance will fall forward toward the target due to the inertia of the aircraft. This distance is determined for planning purposes based on the speed and altitude of the aircraft. Normally, gravity drop-bombing is used by bombers at medium and high altitudes, but it may also be used by fighter-bombers at lower altitudes. This technique can be used to deliver nuclear as well as conventional ordnance.

Dive-Bombing. Aircraft using this attack technique start the attack run at medium altitude and dive directly at the target. Ordnance release will occur at low-to-medium altitudes. After delivering the

ordnance, the aircraft will execute an evasive maneuver. As in gravity drop-bombing, the ordnance falls forward, usually less than 1 kilometer.

Toss-Bombing. Aircraft using this attack technique usually enter at a low-to-medium altitude. At a predetermined point, the aircraft goes into a steep climb. The aircraft then releases its ordnance and reverses its direction. The ordnance can be thrown forward as far as 18.3 kilometers, but the accuracy of ordnance delivery is poor.

Standoff. Aircraft equipped with ASMs and PGMs can, with a few types of specialized ordnance, stand off beyond the effective range of ADA systems and release ordnance against the defended asset. The ordnance itself then becomes the threat. ASMs have ranges up to 500 kilometers. There is no fixed altitude required for ASM release.

Pop-up. Aircraft using the pop-up technique begin a low-level run-in about 10 to 20 kilometers from the target. When reaching a pull-up point about 3 to 8 kilometers offset from the target, the aircraft will climb to its attack height. This height will vary from 300 to 2,000 meters, depending on the terrain and type of ordnance used. Air speed will also vary, but it will generally be between 200 and 250 meters per second. The pilot begins to look for the target as soon as possible after pull-up. He has only a few seconds to find the target if minimum exposure time is to be achieved. The aircraft will then dive at the target and release its ordnance 500 to 1,500 meters from the target. It then escapes the target area at high speed and low altitude.

Lay-down. Aircraft using the lay-down technique fly at altitudes below 200 meters and at speeds from 150 to 250 meters per second. High speed and low altitude increase aircraft survival and mission success. The speed of ordnance fall is reduced by ordnance retardation devices, such as drogue chutes or retarding fins. This allows the aircraft to escape the target area before the ordnance detonates. Runway cratering bombs are frequently delivered by this method.

Learning Event 6:
SOVIET TACTICS

The Future Air Battle

The study of recent conflicts and current threat analysis provides clear insights into the nature of the future air battle. The next air battle will be a large numbers game played by both sides in terms of aircraft and ADA systems. The Soviets will bring together air attacks from multiple, dispersed air bases in an attempt to gain air superiority. At the same time, they will be playing the AD game to protect their own forces.

Friendly forces can expect that enemy air will initially outnumber friendly air. In any event, it must not be assumed that US forces will have air superiority, except perhaps in limited areas for short periods of time. This leads to the concept of two distinct phases to the air battle.

First Phase of the Air Battle

The first phase of the air battle will consist of high-risk operations designed to gain air superiority and to neutralize theater nuclear forces. Soviet forces will dedicate all available assets to this effort,

including strategic aviation, naval aviation, tactical aviation, and the strategic rocket forces. Their air forces will attempt to punch holes or lanes through our forward HIMAD units. Successive waves of aircraft will use these lanes to attack our bases, command and control facilities, key logistics installations, and theater nuclear forces. If this initial air operation is successful, our retaliatory capability will be greatly reduced and the ability to sustain ground forces greatly degraded.

In the first-phase air battle (Figure 9), Soviet aircraft will be loaded with munitions optimized to knock out our ADA units and to kill aircraft on air bases and in the air. While the air superiority phase will continue as long as conflict exists, it is the first attack which will be critical. As with the other combat arms, ADA must win the first battle. Our success will determine--

- The size of initial and subsequent attacks on our ground forces.
- The amount of CAS available to our ground forces.
- Our freedom of maneuver despite enemy air actions.
- The survivability of our logistics support systems.

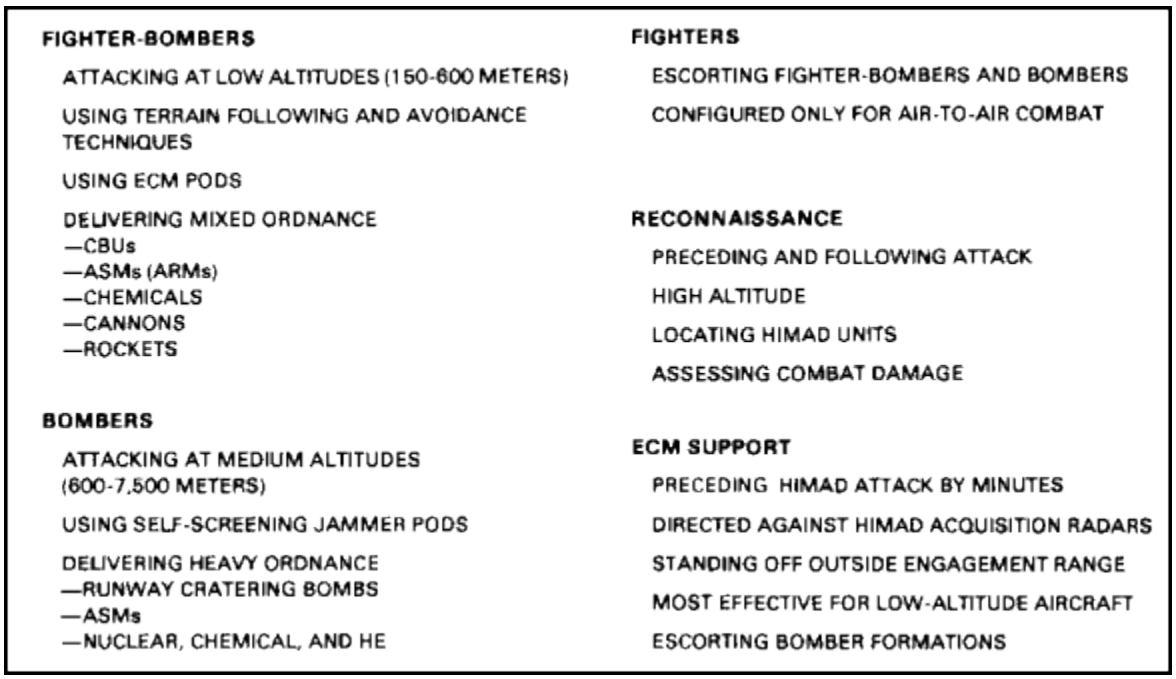


FIGURE 9. FIRST-PHASE AIR BATTLE.

Second-Phase of the Air Battle

After the initial waves of air superiority attacks, the Soviets will shift their emphasis to CAS of maneuver forces. The second phase of the air battle will be the attack of maneuver forces and their support elements. If they fail to achieve air superiority, the second phase may be delayed and continued attacks could be directed against our ADA forces.

In the second phase (Figure 10), Soviet aircraft will attack forward maneuver elements, as well as command and control, fire support, and logistic assets in brigade and division areas. Enemy flights will approach the forward edge of the main battle area at low altitudes to avoid HIMAD weapons. Most

attacks on ground targets will be at altitudes below 1,000 meters and at speeds less than 250 meters per second. Flights will probably be composed of two to four aircraft. As they near their targets, these flights may divide into two separate elements. The aircraft may execute a pop-up maneuver when approaching the target area. The first element will attack, deliver its ordnance, and then escape the target area. The second element will follow almost immediately. Elements may make a second attack on the target if they have unexpended ordnance.

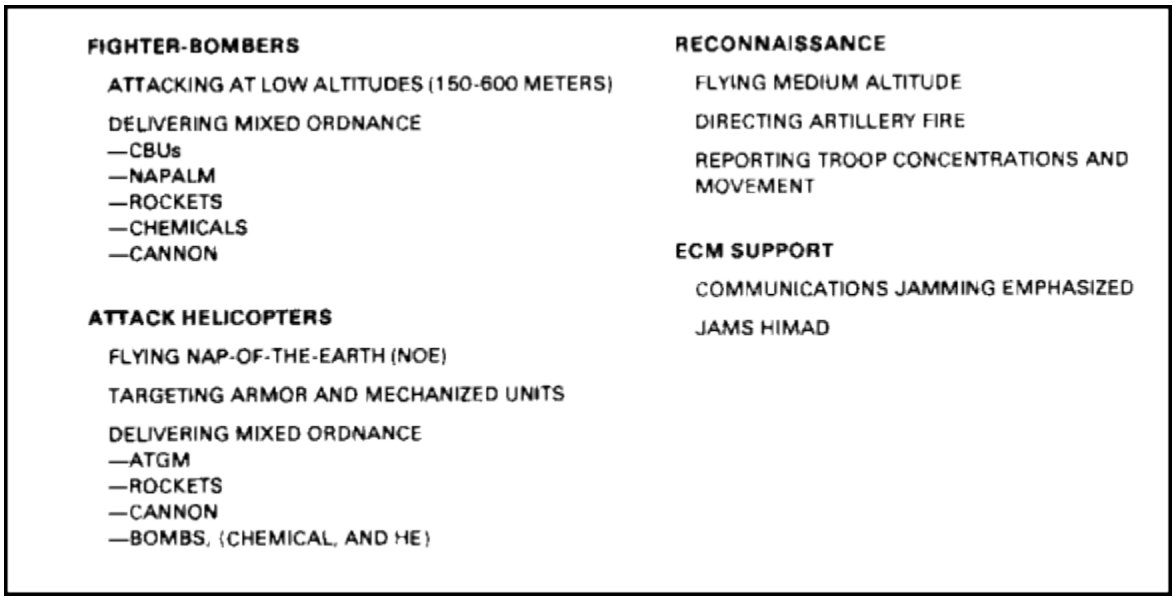


FIGURE 10. SECOND-PHASE AIR BATTLE.

Learning Event 7:
THREAT AIRCRAFT

As long as an aircraft in the Soviet inventory has the utility for combat, it is not scrapped because of obsolescence. Older aircraft are modified to support new missions. In many cases, when older equipment is replaced in the active threat air force, it is transferred to reserve elements or passed on to allies. In recent years, the mission of the threat air force has been expanded. Missions now include destroying friendly nuclear reserves and tactical air forces and providing tactical air support of ground forces. Through the 1960s, and with increasing tempo through the 1970s and 1980s, threat air forces have received new aircraft and munitions with greatly improved offensive capabilities.

The threat aircraft inventory was dominated during the early 70s by comparatively unsophisticated aircraft. These were almost entirely replaced or augmented over the course of the last decade by dual-role warplanes offering double the tactical radius and triple the ordnance potential. With good LO-LO-LO penetration, flight profile capabilities, and relatively sophisticated avionics, the threat has an all-weather capability for the first time. Threat aircraft carry a varied assortment of air-to-surface ordnance. These range from laser-guided bombs and electro-optical and laser-guided missiles to cluster munitions and specialized airfield attack weapons.

A review of the threat's air inventories shows that its air forces can and will employ a wide range of aircraft.

Multirole Aircraft

Multirole aircraft are designed to perform both air-to-air combat missions and ground attack missions. Threat assets within this category include the MiG-17, -19, -21, -23, and 27; the Yak-28; and the Su-24.

These aircraft will be targets for both HIMAD and SHORAD systems and will be seen in large numbers by both. SHORAD systems operating with units near the FEBA will mostly observe the aircraft as they pass through the forward area on their way to strike deeper targets, or while they provide AD protection for other aircraft. SHORAD systems operating to the rear of the FEBA will engage these aircraft as they attack targets (Figure 11).

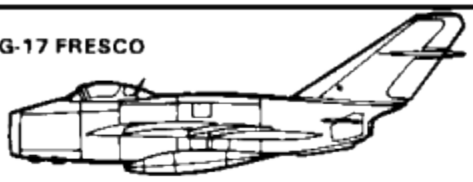
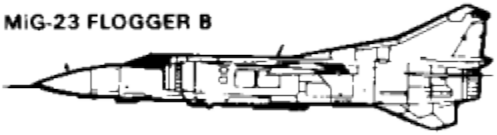
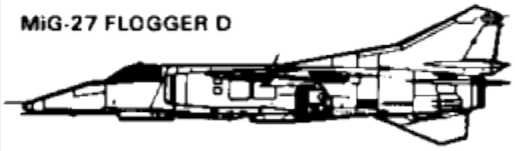
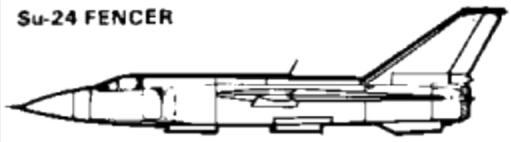
AIRCRAFT	ROLE	MAXIMUM SPEED ALTITUDE/SEA LEVEL (km/hr)	COMBAT RADIUS (km)
MiG-17 FRESCO 	Air-to-Air/ Ground Attack	1,145/1,125	500-700
MiG-19 FARMER 	Air-to-Air/ Ground Attack	1,450/unk	685
MiG-21 FISHBED 	Air-to-Air/ Ground Attack/ Reconnais-sance/ECM	2,250/1,100	650
MiG-23 FLOGGER B 	Air-to-Air/ Ground Attack/ Reconnais-sance/ECM	2,445/1,350	965
MiG-27 FLOGGER D 	Air-to-Air/ Ground Attack/ ECM	1,700/1,300	900
YAK-28 BREWER-E 	Air-to-Air/ Ground Attack/ Reconnais-sance/Bomber/ ECM	1,225/unk	965-1,290
Su-24 FENCER 	Air-to-Air/ Ground Attack	2,655/1,530	400-1,200

FIGURE 11. MULTIROLE AIRCRAFT CHARACTERISTICS.

Reconnaissance Aircraft

The threat uses reconnaissance aircraft equipped with photographic and electronic sensors. This equipment is capable of detecting our operations in daylight, darkness, and inclement weather. Reconnaissance aircraft may operate alone, but probably will operate jointly with ground attack aircraft. Used in this manner, reconnaissance aircraft (Figure 12) detect targets of opportunity for the ground attack aircraft. Reconnaissance versions of MiG-21 and -25 aircraft perform deep penetration missions and also provide reconnaissance coverage nearer the FEBA. Other aircraft available for reconnaissance missions include the Yak-28 Brewer and the II-28R Beagle.

Reconnaissance missions will normally be flown at higher altitudes outside the range of SHORAD systems.

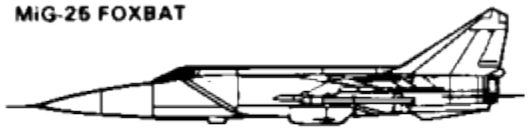
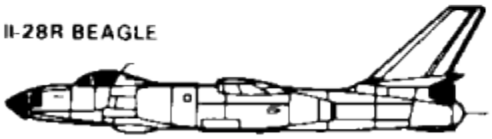
AIRCRAFT	ROLE	MAXIMUM SPEED ALTITUDE/SEA LEVEL (km/hr)	COMBAT RADIUS (km)
MiG-25 FOXBAT 	Air-to-Air/ Reconnais-sance/ECM	2,865/unk	1,130
II-28R BEAGLE 	Reconnais-sance/Bomber	503/unk	2,260

FIGURE 12. RECONNAISSANCE AIRCRAFT CHARACTERISTICS.

Ground Attack Aircraft

Later models of dedicated ground attack aircraft provide threat forces with effective LO-LO-LO strike and interdiction capabilities at night and in adverse weather. The Fitter C, developed from the Fitter A, carries almost twice the ordnance of its predecessor.

The Su-25 Frogfoot ground support fighter is a specifically designed ground attack aircraft like the USAF A-10. The Frogfoot is reported to carry a 30-millimeter cannon, based on the Gatling gun principle. This aircraft is designed to fly high-performance missions and is capable of carrying a wide variety of munitions (Figure 13).

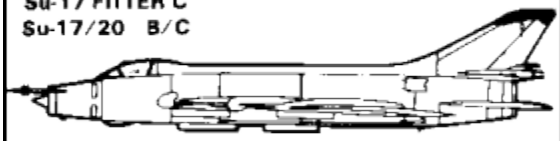
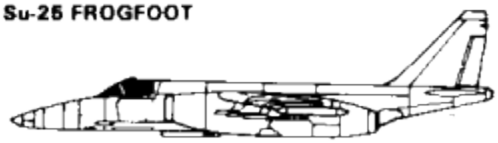
AIRCRAFT	ROLE	MAXIMUM SPEED ALTITUDE/SEA LEVEL (km/hr)	COMBAT RADIUS (km)
Su-7B FITTER A 	Ground Attack	1,930/850	320-485
Su-17 FITTER C Su-17/20 B/C 	Ground Attack	2,305/1,285	360-630
Su-25 FROGFOOT 	Ground Attack	1,000/904	276

FIGURE 13. GROUND ATTACK AIRCRAFT CHARACTERISTICS.

Bombers

The primary mission of the threat strategic bomber force is to strike peripheral and intercontinental targets with nuclear or conventional weapons. It is also responsible for performing long-range reconnaissance in support of other force components. The Soviet bomber aircraft include the Backfire B, Bison, Badger A, Blinder A, and the Bear. These aircraft provide the Soviets with a strong and effective bomber force. They normally operate at altitudes beyond SHORAD capability (Figure 14).

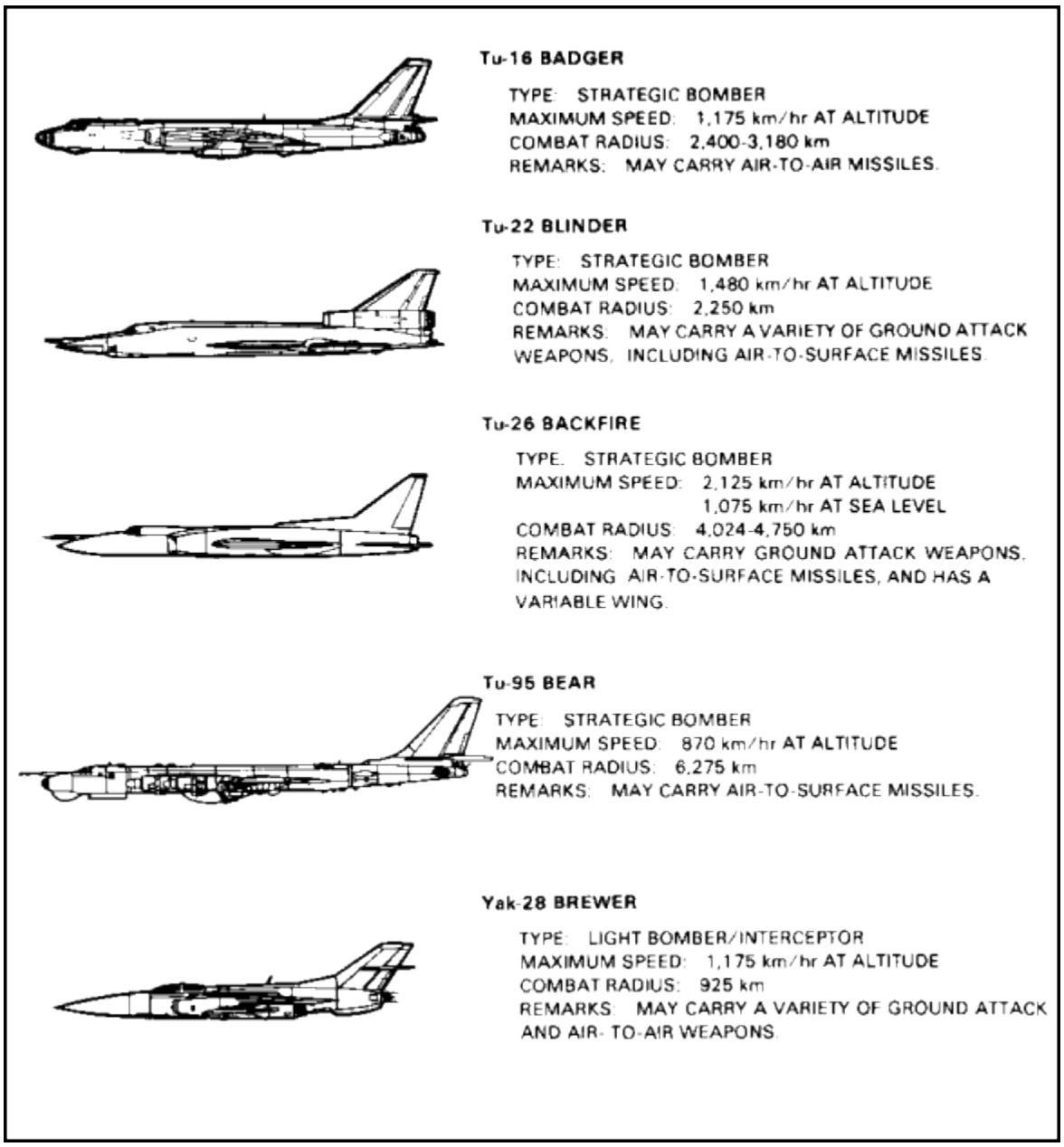


FIGURE 14. BOMBER CHARACTERISTICS.

Long-Range Aviation

The threat to the rear area consists of both LRA and tactical aviation. It is intended primarily for use against strategic targets. However, it may also be employed against targets that are found in the theater area.

The threat inventory currently consists of forces of approximately 800 aircraft. This does not include long-range reconnaissance and in-flight refueling tankers.

The primary air threat to CONUS is from the long-range Bear and Bison force. The newer bomber, the Backfire, is also assigned to the LRA contingent. When operating with aerial tankers, the Backfire can achieve considerable ranges.

Penetration to the target will be made either by flying at extremely low altitudes or by flying at high altitudes. Bombers may also be preceded by aircraft which are equipped with ECM devices and decoys to confuse our defenses. Others will be equipped with antiradiation missiles to suppress our radars.

Learning Event 8:
BOMBER ATTACK PROFILES AND TECHNIQUES

Bomber aircraft can fly in zones of low risk and high risk where HIMAD defenses are thick. For example, a bomber may fly high on a HI-LO-HI flight mission profile against a target in the deep rear to evade a HIMAD belt. It would make a final low run as it approaches the target and then make its escape at a higher altitude. In the LO-LO-LO profile, the bomber approaches the target flying at low altitude, bombs the target, and then makes its escape while still flying at low altitude. This profile requires the aircraft to have a forward-looking, terrain-avoidance radar to avoid terrain obstruction. The LO-LO-HI attack mission profile allows the bomber to fly in low on the bomb run, attack the target, and escape by flying away at high altitude (Figures 15 and 16).

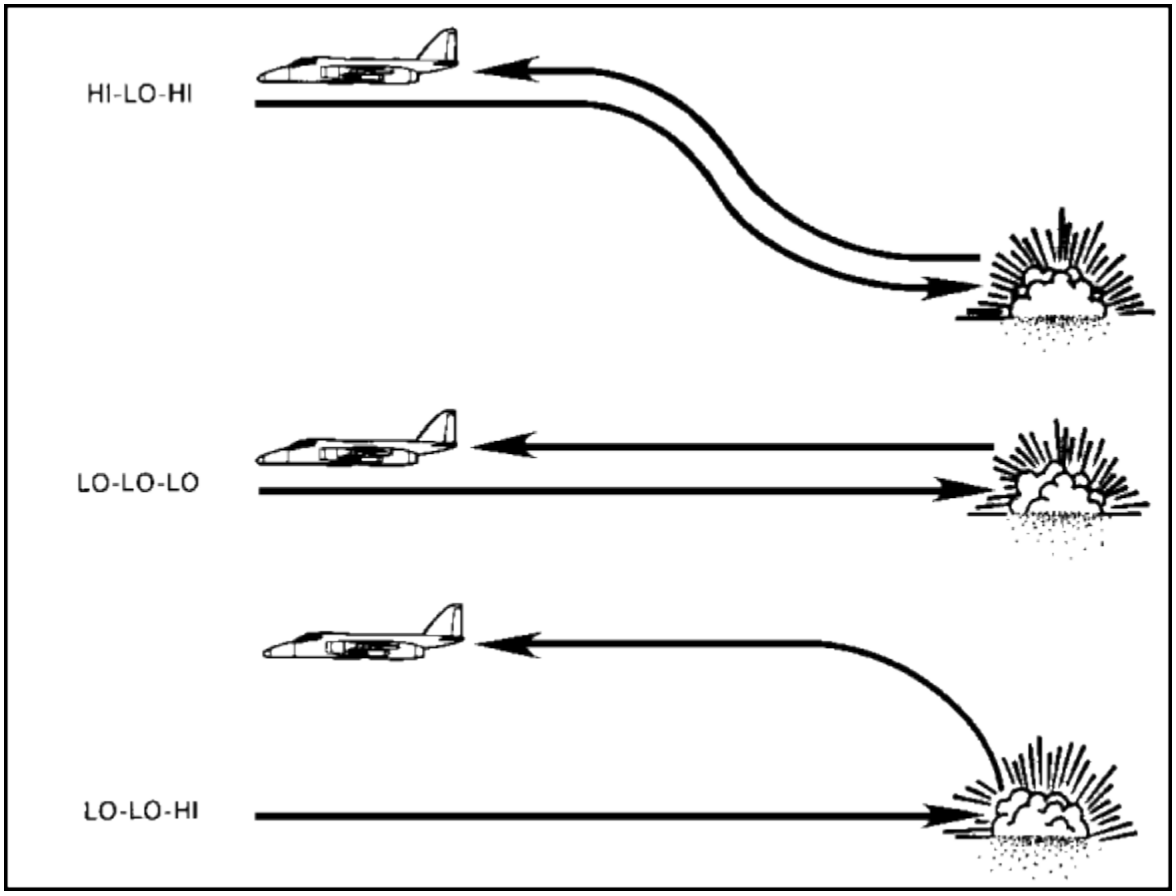


FIGURE 15. TYPICAL MISSION FLIGHT PROFILES.

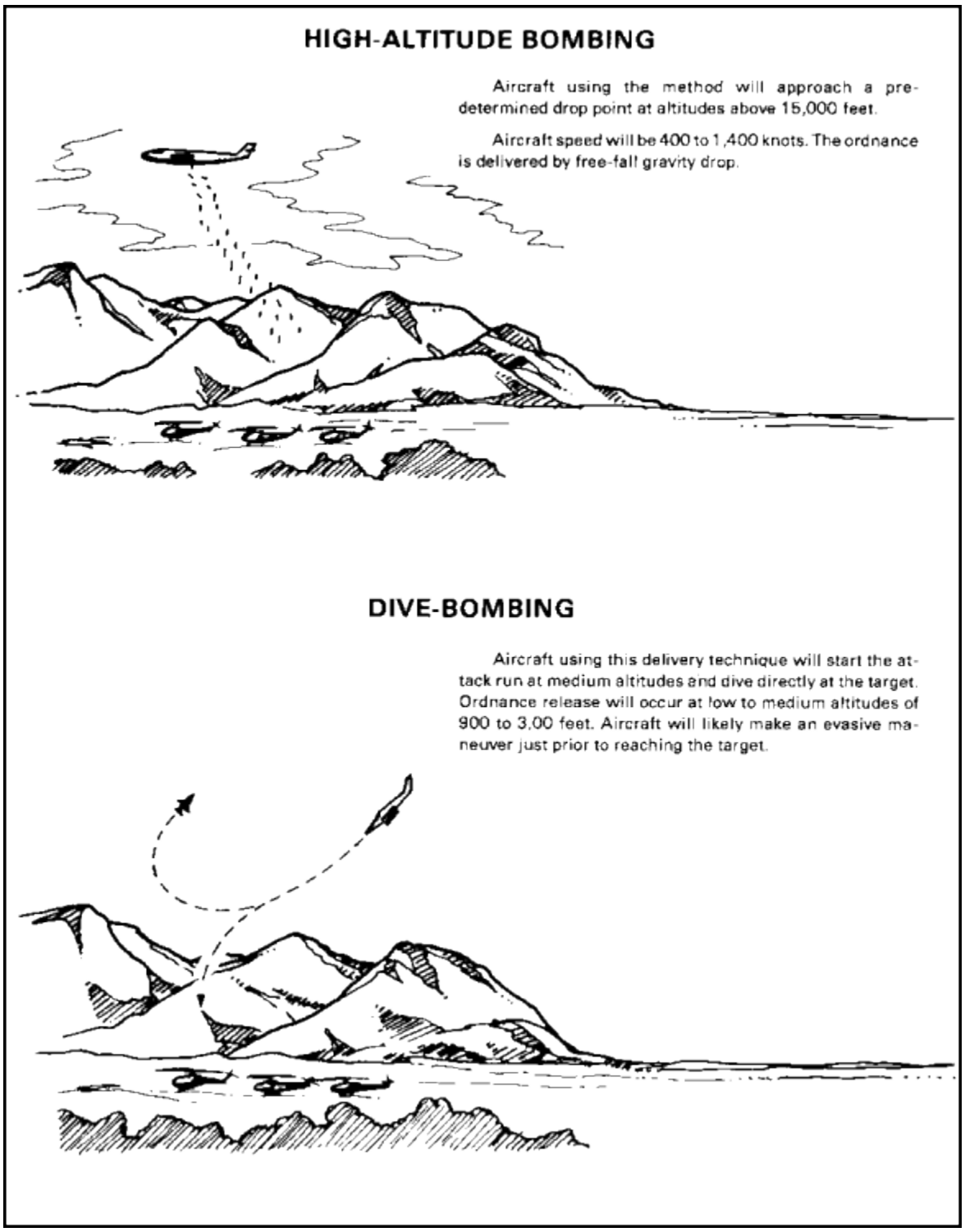


FIGURE 16A. BOMBER DELIVERY TECHNIQUES.

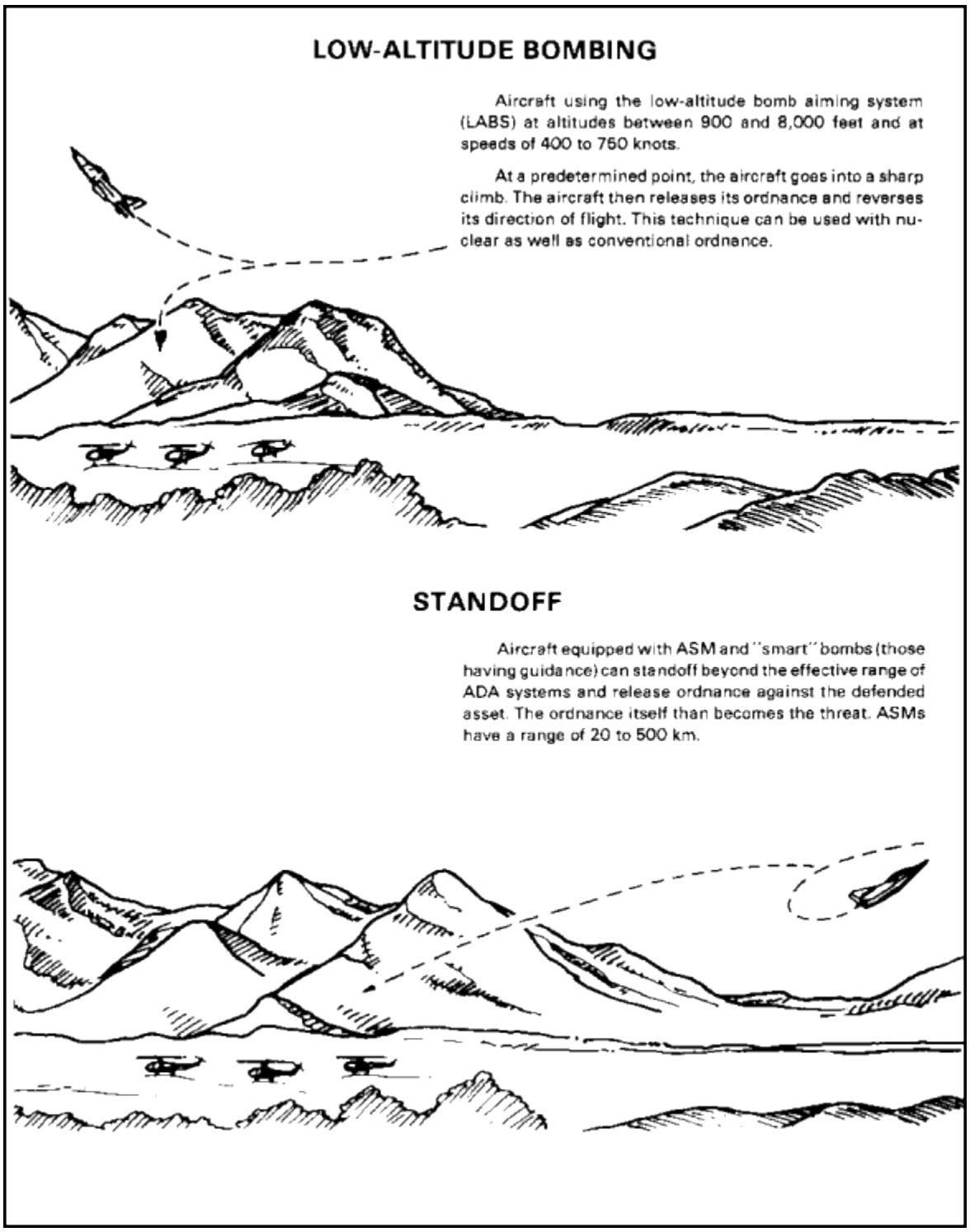


FIGURE 16B. BOMBER DELIVERY TECHNIQUES (Continued).

Transport Aircraft

Soviet transport aviation is basically a support. It has the mission of providing airlift services for the Soviet armed forces and the national government. In wartime, the most important function will include providing airlift support for airborne operations and movement of troops and materiel. The aircraft involved in Soviet transportation include the An-12 Cub, An-22 Cock, I1-76 Candid, with new

additions being the An-72 Coaler and the long-range heavy transport. The Soviet transport aircraft also have a responsibility for providing wartime airborne ECM support for their own airlift and airdrop operations.

Learning Event 9:
HELICOPTER THREAT

As stated in Learning Event 7, threat forces have some of the most heavily armed helicopters in the world. These helicopters may be employed both in the overwatch near the FEBA and in air assaults against rear areas.

As previously indicated, helicopters have advantages over fixed-wing aircraft which enable them to be deployed in large numbers in forward areas. They do not require large airfields or costly runways. They are suitable for conducting reconnaissance of the enemy's forward forces. They are highly mobile and can fly in weather that would ground fixed-wing aircraft. Finally, they can carry a wide variety of weapons including cannons, machine guns, ATGMs, free-flight rockets, and grenade launchers.

These valuable characteristics are offset by the helicopter's vulnerability to SHORAD weapons. The attack helicopter achieves maximum utility in a war of movement when employed in an ambush or assault. Using speed, mobility, surprise, and an impressive array of weapons, it can harass, delay, and destroy advancing armor and mechanized columns and support the ground attacks with firepower. Attack helicopters can be used to lay mines, destroy bridges, and create other obstacles to stall the movement of ground forces.

The Mi-24 Hind is the first threat helicopter specifically designed for attack missions. However, it is capable of landing a squad behind enemy lines. There are currently five versions of the Hind. The first three, Hind A, B, and C, differ basically in the ordnance they carry. The fourth version, the Hind D, features a completely redesigned front fuselage. The Hind D's armament capabilities exceed those of the Hind A. The Hind D has a four-barrel Gatling gun instead of the single-barrel machine gun of the Hind A and four launch racks for the At-2 Swatter or At-3 Sagger ATGM. Another later version is the Hind E, which is basically the same as the Hind D, except it is equipped with AT-6/Spiral ATGMs on launch tubes under each of its wings.

Other helicopters which may be targets for ADA systems are the Mi-2 Hoplite, which acts as a spotter for attack helicopters, and the Mi-6 Hook helicopter. Helicopters are the primary target for SHORAD systems in the forward area and may be targets for other SHORAD and HIMAD systems during deep airmobile assaults or reconnaissance missions. Characteristics of threat helicopters are shown in Figure 17.

NAME	PASSENGERS	CARGO (kg)	MAXIMUM SPEED (km/hr)	CRUISING SPEED (km/hr)	RANGE (km)
Mi-1 HARE 	2-3	300	170	140	389
Mi-2 HOPLITE 	8-10	700 (internal) 800 (external)	209	190	170-580
Mi-4 HOUND 	12-16	1,200	213	177	274-463
Mi-6 HOOK 	65	12,000 (internal) 8,000 (sling)	300	250	204-612
Mi-8 HIP 	24	4,000 (internal) 3,000 (external)	230	225	163-406
Mi-10 HARKE 	28	15,000 (gripper) 8,000 (sling)	200	180	135-567

FIGURE 17A. CHARACTERISTICS OF THREAT HELICOPTERS.

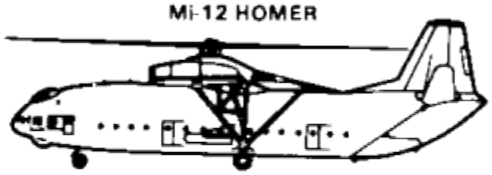
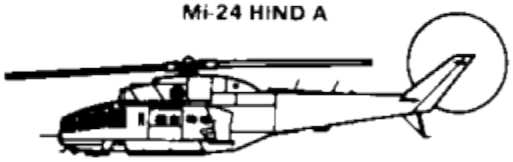
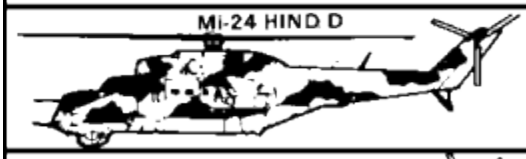
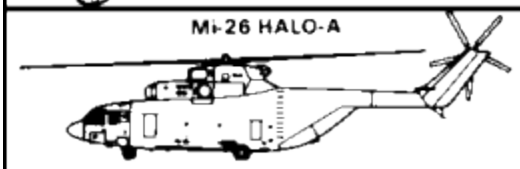
NAME	PASSENGERS	CARGO (kg)	RANGE (km)	MAXIMUM SPEED (km/hr)	CRUISING SPEED (km/hr)
Mi-10K HARKE 	28	14,000 (sling)	220	200	250-630
Mi-12 HOMER 	200	30,000	260	240	200-390
Mi-24 HIND A 	8	2,900	320	310	491-537
Mi-24 HIND D 	8	Not available	320	310	Probably same as HIND A
Mi-26 HALO-A 	70 (est)	18,000 (internal) 20,000 (external)	300	250	800-1,200

FIGURE 17B. CHARACTERISTICS OF THREAT HELICOPTERS (Continued).

Drones and RPVs

Drones and RPVs receive guidance from one of the following sources:

- Accompanying manned aircraft.
- Ground control stations.
- On board, programmable navigation systems.

Drones and RPVs may be used in the initial stages of air operations. Their use will continue throughout the conflict. These vehicles are used for reconnaissance, ordnance delivery, and ECM. They are also used to deplete AD ammunition stocks without the loss of pilots or aircraft.

Learning Event 10:
THE THREAT AND AD

The picture should now be relatively clear. The enemy is quantitatively superior to friendly forces in aircraft, and the first fight--for air superiority--can be won only if ground-based AD weapons can help meet Phase I attacks. The attacker, regardless of his Phase I success, must enter into Phase II, when the

battle is joined by ground forces, and a combination of aircraft and ground-based systems is again required for friendly success. ADA forces must then be prepared to meet the first attacks, and they must exact a heavy toll. Possibly more important is the fact that significant numbers of AD weapons must survive Phase I to participate in Phase II. Then they must again be successful if we are to win the first battle.

Is AD necessary? The answer should be apparent. United States ground forces have been fortunate, because more than 30 years have passed since they have actually faced a significant air threat on the battlefield; but that luxury has now been exhausted. The next time we find ourselves engaged in combat, our opposition will have and will project a serious air threat into the conflict. A combined arms team minus AD assets will not win.

It should also be apparent that a combination of aircraft and ground-based AD systems will be required to counter any future air threat. Before looking at how the US will employ its Army AD systems, consider the ground-based AD weapons that may be employed by the enemy.

The Soviet requirement for the AD of their mobile formations has been met by saturating the airspace from low-to-high altitudes, using integrated systems of conventional weapons and SAMs. Field formations rely on vehicle-mounted SAMs and mobile guns to protect their fast-moving tank and motorized rifle units. This mix of guns and missiles provides a mobile umbrella that accompanies each echelon, including forward-deployed battalions. As new AD systems are introduced into their forces, the older systems are still retained in the active weapon inventory.

To offset or reduce an opposing air force's combat power effectiveness, Soviet doctrine advocates saturation of the airspace, from low-to-high altitudes, using an integrated system of conventional AA guns and SAMs. These weapons are augmented by interceptor aircraft and ECM.

Soviet air defenses are established to provide both area and point protection for troops and objectives. Area coverage is provided by SAM systems, and point protection is provided by divisional and regimental light AD weapons. Normally, division commanders personally direct the placement of AD weapons, the laying down of fire support coordination lines, and the establishment of priorities and procedures for supply and technical support during the planning phase of an operation. The divisional AD commander then plans deployment of his assets based on the division commander's instructions, the air situation, and the demands for command and control (Figure 18).

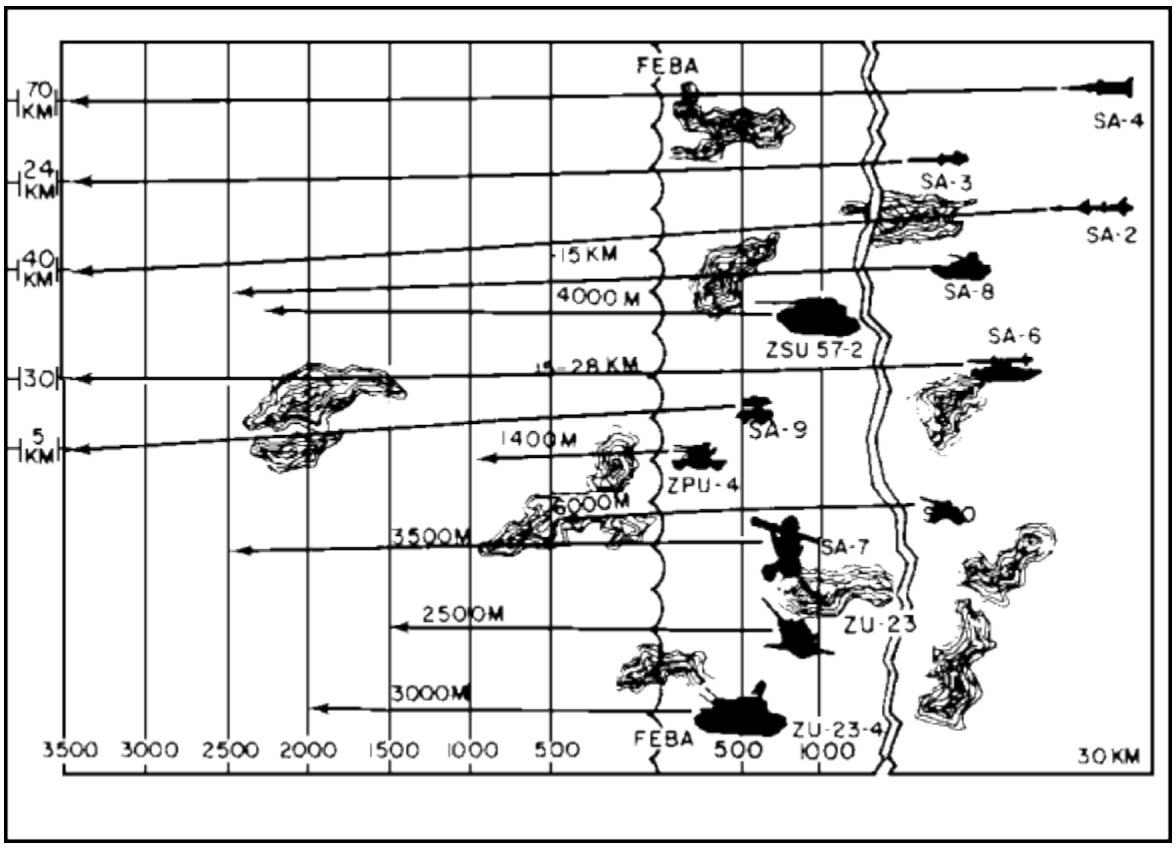


FIGURE 18. SOVIET MISSILE AND ANTIAIRCRAFT SYSTEMS DEPLOYED IN FORWARD AREAS

Practice Exercise
Lesson 1

Instructions The following items will test your understanding of the material covered in this lesson. There is only one correct answer for each item. When you have completed the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, review that part of the lesson which contains the portion involved.

1. What is the primary mission of Army ADA?

   - ○ A. To nullify or reduce the effectiveness of hostile aircraft or missiles, thereby supporting the Army's ability to conduct sustained land operations.
   - ○ B. To nullify or reduce the effectiveness of hostile aircraft or missiles, thereby protecting US air bases from attack.
   - ○ C. To nullify or reduce the target signature of US installations, thereby ensuring sustained service support to the Army in the field.
   - ○ D. To ensure US air superiority by attiring the enemy air force, thereby supporting the Air Force's ability to conduct sustained air operations.

2. When was the Krupp gun (75-millimeter) developed, and what was its primary target?

   - ○ A. During World War I to combat German air attacks on convoys.
   - ○ B. Between World War I and World War II in Germany to oppose the new British and American bombers.
   - ○ C. During the Franco Prussian War (1870) to combat French observation balloons.
   - ○ D. During the American Civil War to improve the accuracy of the rifled cannon against Union observation balloons.

3. Which list details the most likely characteristics of the air battle in a major conflict with threat forces?

   - ○ A. Small number of aircraft traveling at extremely high speed carrying specifically designated munitions, including air-to-ground missiles for deliberate, highly structured actions.
   - ○ B. Attack by large numbers of aircraft on a few selected targets, early morning, limited munitions, uncongested airspace, long-range ballistic missiles, deliberate action, and optical-lazer conflict.
   - ○ C. Attack by a large number of missiles, surprise, primarily nuclear munitions, congested airspace, short-range aircraft, deliberate action, and dense electromagnetic conflict.
   - ○ D. Attack by large numbers of aircraft on multiple targets, surprise, many types of munitions, congested airspace, short-range ballistic missiles, urgency of actions, and dense electro-magnetic conflict.

4. What are the three bomber attack profiles?

   - A. HI-LO-HI; LO-HI-LO; HI-HI-HI.
   - B. HI-LO-HI; LO-LO-HI; LO-LO-LO.
   - C. LO-LO-HI; LO-LO-LO; HI-HI-LO.
   - D. LO-LO-LO; HI-HI-HI; LO-LO-HI.

5. The _____ is the first Soviet helicopter specifically designed for attack missions.

   - A. Mi-2 Hoplite
   - B. Mi-6 Hook
   - C. Mi-8 Hoplite
   - D. Mi-24 Hind

6. Which of the following best states the unique AD lessons learned in the Pacific Theater during WW II?

   - A. Adequate early warning, aircraft identification, and uniform command and control are critical to asset survival, and AD is of great importance to a force not having air superiority.
   - B. AD without air supremacy is of little significance; therefore, primary resources should be focused on the maintenance of a strong offensive air force.
   - C. Adequate early warning could not have prevented the Japanese attack on Pearl Harbor or US air attacks on Japan. AD forces are therefore of little strategic consequence.
   - D. Offensive air supremacy without AD is of little significance; therefore, primary resources should be focused on the maintenance of a strong AD.

7. The primary mission of threat strategic bombers is _____.

   - A. to provide CAS for ground forces
   - B. to provide AD
   - C. to strike peripheral and intercontinental targets with nuclear or conventional weapons
   - D. to conduct aerial reconnaissance

8. The Soviets would most likely use _____ munitions against Hawk or Patriot sites during an attack.

   - ○ A. bomb
   - ○ B. CBU
   - ○ C. rockets
   - ○ D. 23- or 30-millimeter

9. High-performance, fixed-wing aircraft rely on _____ for surprise and survival.

   - ○ A. high altitude
   - ○ B. low altitude
   - ○ C. attack technique
   - ○ D. speed and ECM

10. Soviet doctrine stresses maintaining the momentum of attack by _____.

    - ○ A. use of air assault missions
    - ○ B. using chemicals and biological agents
    - ○ C. using nuclear strikes
    - ○ D. attacking at night

11. The most significant advantage of drones is the _____.

    - ○ A. aerial reconnaissance by cameras
    - ○ B. reconnaissance of NBC contaminated areas
    - ○ C. elimination of pilot loss
    - ○ D. reconnaissance of fire unit positions

12. What Soviet fighter currently in service has a secondary ground attack capability greater than the Fishbed or Fitter?

    - ○ A. MiG-23 Flogger B.
    - ○ B. Foxbat.
    - ○ C. Frogfoot.
    - ○ D. Badger.

13. What do the Soviets hope to accomplish during the first phase of the air battle?

- ○ A. Gain air superiority and neutralize theater nuclear forces.
- ○ B. Eliminate resupply facilities and war stocks.
- ○ C. Eliminate war industry and other strategic targets.
- ○ D. Destroy mobility of ground forces.

14. What changes will probably occur as Phase II of the air battle begins?

- ○ A. Enemy aircraft will attack to pound committed divisions.
- ○ B. The Soviets will shift emphasis to CAS of maneuver forces.
- ○ C. All attacks in the rear will cease.
- ○ D. Attack helicopters will attempt to hit such assets as ammunitions and petroleum storage.

15. Who normally directs the placement of Soviet AD weapons?

- ○ A. Supported unit commander.
- ○ B. Division commander.
- ○ C. Corps commander.
- ○ D. AD battalion commander.

16. What is the specific objective of AD?

- ○ A. To gain air superiority from the outset.
- ○ B. To gain superior ground force maneuver elements.
- ○ C. To counter threat aircraft opposing US forces in the forward area.
- ○ D. To protect US forces in the field and ensure them freedom of maneuver.

17. In wartime, Soviet transport aircraft provide the most important function of _____.

- ○ A. reconnaissance near the FEBA
- ○ B. strike and interdiction capabilities at night
- ○ C. airlift support for airborne operations and movement of troops and materiel
- ○ D. self-defense escort jamming on missions across the FEBA

18. The LRA threat inventory consists of approximately how many aircraft?

- ○ A. 500.
- ○ B. 700.
- ○ C. 800.
- ○ D. 1,000.

19. As new AD systems are introduced into the Soviet forces, the older systems are _____.

- ○ A. still retained in the active weapon inventory
- ○ B. modified to current specifications
- ○ C. refitted into drone aircraft
- ○ D. dismantled and later used as experimental aircraft

20. Helicopters are the primary target for _____ systems in the forward area.

- ○ A. HIMAD
- ○ B. SHORAD
- ○ C. Vulcan and Chaparral
- ○ D. Roland and Duster

PRACTICE EXERCISE ANSWERS

1. What is the primary mission of Army ADA?

a. To nullify or reduce the effectiveness of hostile aircraft or missiles, thereby supporting the Army's ability to conduct sustained land operations.
b. To nullify or reduce the effectiveness of hostile aircraft or missiles, thereby protecting US air bases from attack.
c. To nullify or reduce the target signature of US installations, thereby ensuring sustained service support to the Army in the field.
d. To ensure US air superiority by attiring the enemy air force, thereby supporting the Air Force's ability to conduct sustained air operations.

2. When was the Krupp gun (75-millimeter) developed, and what was its primary target?

a. During World War I to combat German air attacks on convoys.
b. Between World War I and World War II in Germany to oppose the new British and American bombers.
c. During the Franco Prussian War (1870) to combat French observation balloons.
d. During the American Civil War to improve the accuracy of the rifled cannon against Union observation balloons.

3. Which list details the most likely characteristics of the air battle in a major conflict with threat forces?

a. Small number of aircraft traveling at extremely high speed carrying specifically designated munitions, including air-to-ground missiles for deliberate, highly structured actions.
b. Attack by large numbers of aircraft on a few selected targets, early morning, limited munitions, uncongested airspace, long-range ballistic missiles, deliberate action, and optical-lazer conflict.
c. Attack by a large number of missiles, surprise, primarily nuclear munitions, congested airspace, short-range aircraft, deliberate action, and dense electromagnetic conflict.
d. Attack by large numbers of aircraft on multiple targets, surprise, many types of munitions, congested airspace, short-range ballistic missiles, urgency of actions, and dense electro-magnetic conflict.

4. What are the three bomber attack profiles?

a. HI-LO-HI; LO-HI-LO; HI-HI-HI.
b. HI-LO-HI; LO-LO-HI; LO-LO-LO.
c. LO-LO-HI; LO-LO-LO; HI-HI-LO.
d. LO-LO-LO; HI-HI-HI; LO-LO-HI.

5. The _____ is the first Soviet helicopter specifically designed for attack missions.

a. Mi-2 Hoplite
b. Mi-6 Hook
c. Mi-8 Hoplite
d. Mi-24 Hind

6. Which of the following best states the unique AD lessons learned in the Pacific Theater during WW II?

a. Adequate early warning, aircraft identification, and uniform command and control are critical to asset survival, and AD is of great importance to a force not having air superiority.
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b. modified to current specifications
c. refitted into drone aircraft
d. dismantled and later used as experimental aircraft

20. Helicopters are the primary target for _____ systems in the forward area.

a. HIMAD
b. SHORAD
c. Vulcan and Chaparral
d. Roland and Duster

LESSON 2

CURRENT AD WEAPON SYSTEMS

TASK

This lesson does not specifically relate to any enlisted or officer tasks, but provides general information on current AD weapon systems.

CONDITIONS

Use only this lesson material to complete the examination.

STANDARDS

You must attain a grade of 70 percent or more on the examination to receive credit for this subcourse.

REFERENCES

The following references are sources for additional information. You do not need them to complete this lesson.

FM 44-1
FM 44-2
FM 44-3
FM 44-15
FM 44-15-1
FM 44-90
FM-44-90-1

Learning Event 1:
SHORAD SYSTEMS

No single AD weapon can protect ground forces against the various attack types and techniques employed by the enemy. A mix of complementary AD weapon systems must be employed in sufficient numbers to be effective. All weapon systems must be integrated into a cohesive defense that is responsive both to the tactical priorities of the maneuver commander and the operational priorities of the AADC and or RADC during the AD battle.

SHORAD weapons are normally employed in support of maneuver forces. They defend the most critical assets against attack by enemy close support aircraft and helicopters. They are also employed in rear areas to defend such assets as air bases, other forces, and key installations in the corps area. SHORAD weapons include both gun and missile systems. The Duster, Vulcan, Chaparral, and MANPAD systems such as Redeye and Stinger are described briefly in the following pages.

Duster

The M42A1 Duster (Figure 19) is a full-tracked armored combat vehicle. It is a designed for deployment with the maneuver forces in the forward combat areas as a means for providing defense

against low-altitude air attack. The M42A1 is also capable of delivering a high rate of fire against enemy ground targets. The vehicle is powered by a horizontally opposed 6-cylinder, supercharged, air-cooled engine, which uses a fuel-injection system. Duster system characteristics are shown in Figure 20.

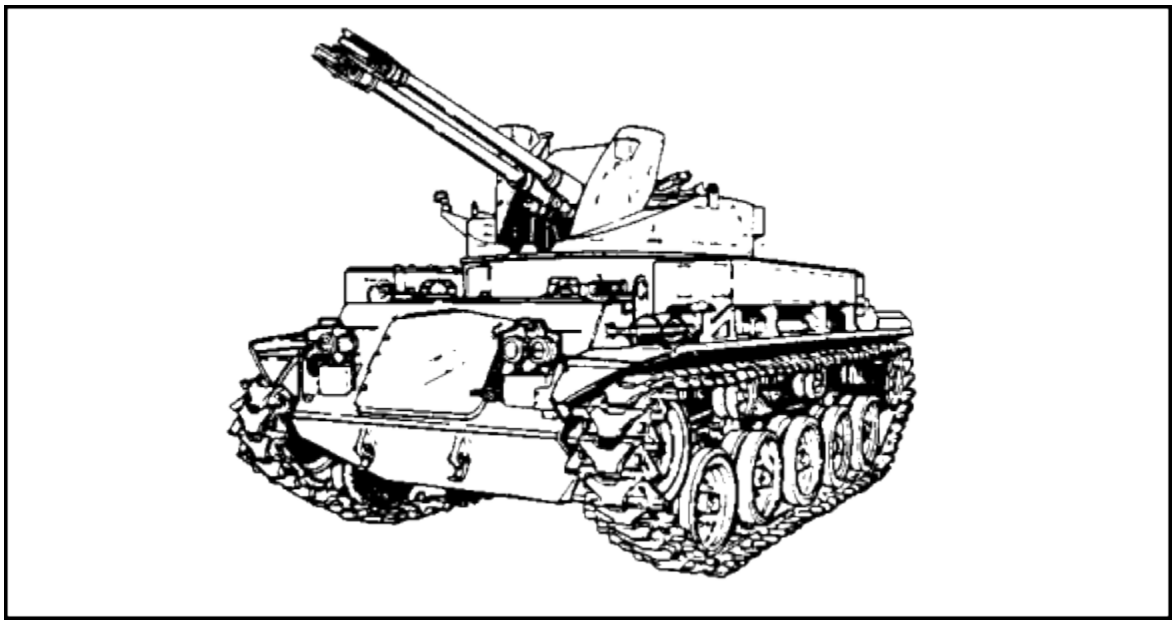


FIGURE 19. DUSTER M42A1.

General Characteristics	Weight, combat loaded		49,500
	Width, overall	3.23 m	(127 in)
	Length, overall	6.38 m	(251 in)
	Height, travel mode	2.87 m	(113 in)
	Allowable speed	72 kmph	(45 mph)
	Cruising range (avg)	161 km	(100 mi)
Weapon Characteristics	Range, aerial/ground	1550-1850 m	
	Traverse limits		360°
	Elevation limits		-5° to +87° manual mode -3° to +85° power mode
Miscellaneous Data	Crew		5 personnel
	Fire control		computing sight M38
	No. of barrels		2
	Barrel life		12,000 rds
	Ammunition		HEI-T SD HE-T SD AP-T

FIGURE 20. DUSTER SYSTEM CHARACTERISTICS.

Engagement Sequence. In a typical duster engagement (Figure 21) the squad leader (1) designates the target, estimates target speed, determines direction of flight, and the angle of dive or climb (2) and sets these values into the computing sight M38 (7). The gunner (3) engages the power drive mechanism and traverses and elevates the gun mount and dual 40-millimeter guns (4) until the target is centered in the retical of the reflex sight M24C (5). The sight mechanically computes the required lead angle (6) based on target speed and flight direction; superelevation is automatically inserted based on gun elevation. When target tracking is steady, the gunner reports ON. Upon receiving the report ON, and having determined that the target is within effective range, the squad leader commands, "Fire." The gunner commences firing and continues to fire until the target is destroyed or the squad leader commands, "Cease firing." The normal mode of firing is the power control mode, using the M38 computing sight. An alternate mode of operation is the manual mode. In this mode the mount and dual gun are moved in azimuth and elevation by hand-operated cranks. When operating in the manual mode, speed ring sights (8) are used for fire control.

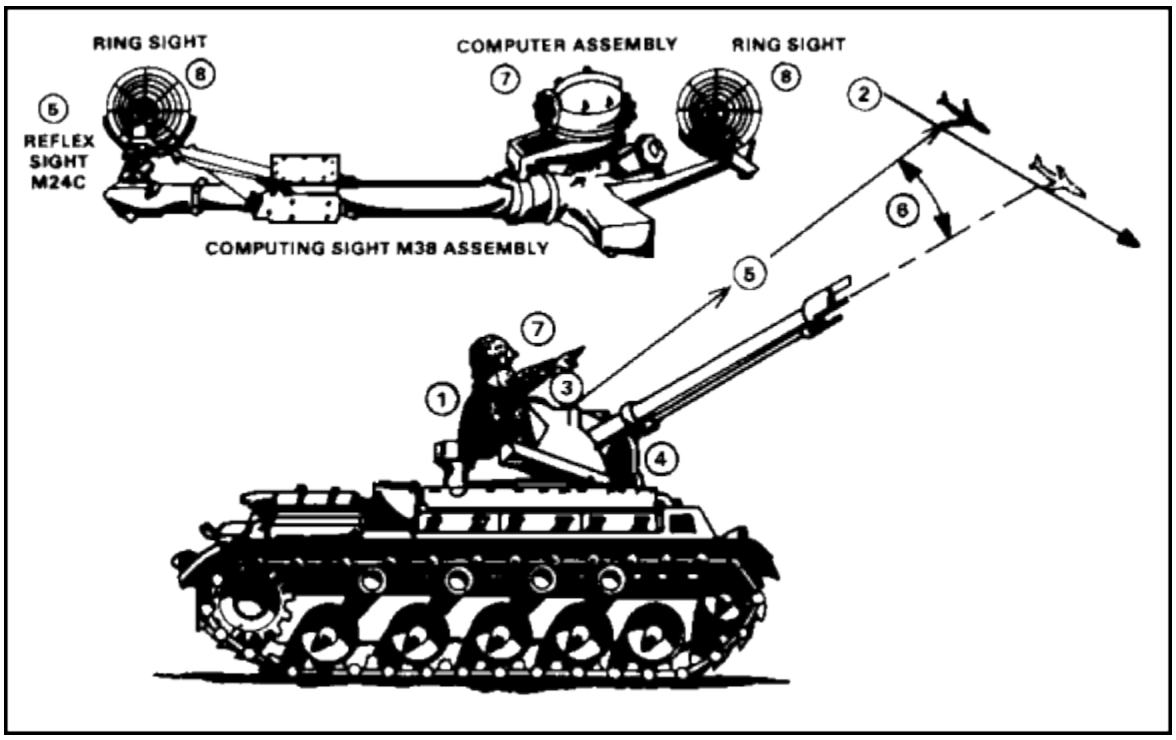


FIGURE 21. DUSTER ENGAGEMENT SEQUENCE.

Vulcan

SP Vulcan. The SP, M163A1, Vulcan (Figure 22) is a full-tracked, lightweight, lightly armored, 20-millimeter gun system designed for deployment, in the combat area to provide AD coverage against the low-altitude air threat. The system is capable of delivering a selected rate of fire (3,000 or 1,000 rounds per minute against air and ground targets. SP Vulcan can be used against stationary or moving ground targets such as personnel, trucks, and lightly armored vehicles. It is highly mobile, capable of high-speed operation on improved roads, cross-country travel over rough terrain, and amphibious operation on streams and small lakes. Also, the system is portable by cargo aircraft.

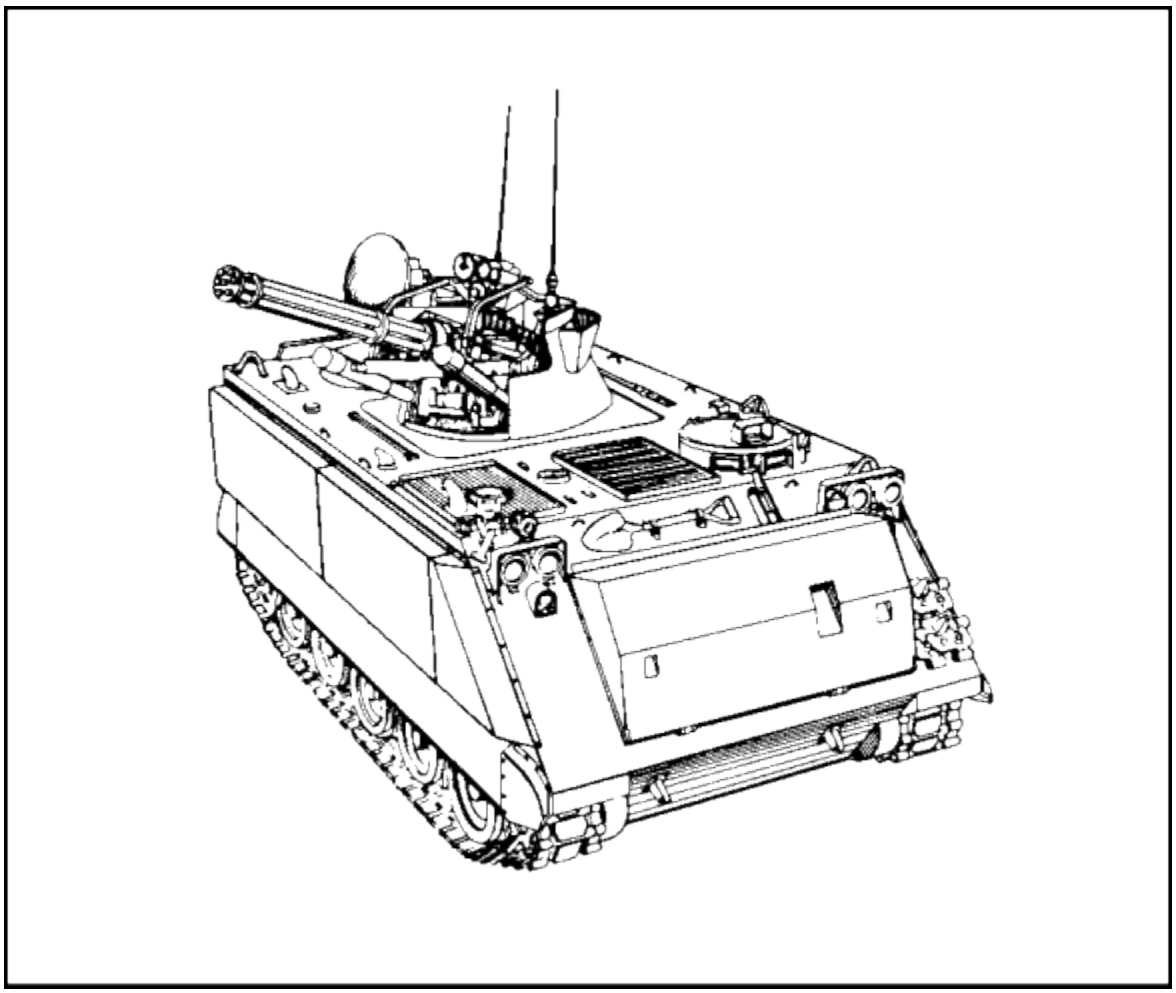


FIGURE 22. SP VULCAN.

Towed Vulcan. The towed Vulcan, M167A1, ADA weapon system (Figure 23) consists of a 6-barrel, 20-millimeter cannon, and a fire control system mounted on a 2-wheel trailer carriage. The system is capable of being towed at high speeds over improved roads, travel over rough terrain, and fording streams to a depth of 30 inches. Towed Vulcan has essentially the same target engagement capability as the SP Vulcan. The cannon characteristics, fire control system, and modes of operation are the same as the SP Vulcan. The primary difference is the towed Vulcan uses a linked feed system and is mounted on a trailer. The system is designed to be towed by a 1 1/4-ton truck M561 (Gamma Goat); however, an adapter permits the system to be towed by the 2 1/2-ton truck M35. The system is air portable by cargo aircraft and helicopter and can be air dropped. The Vulcan gun system's characteristics (SP and Towed) are listed in Figure 24.

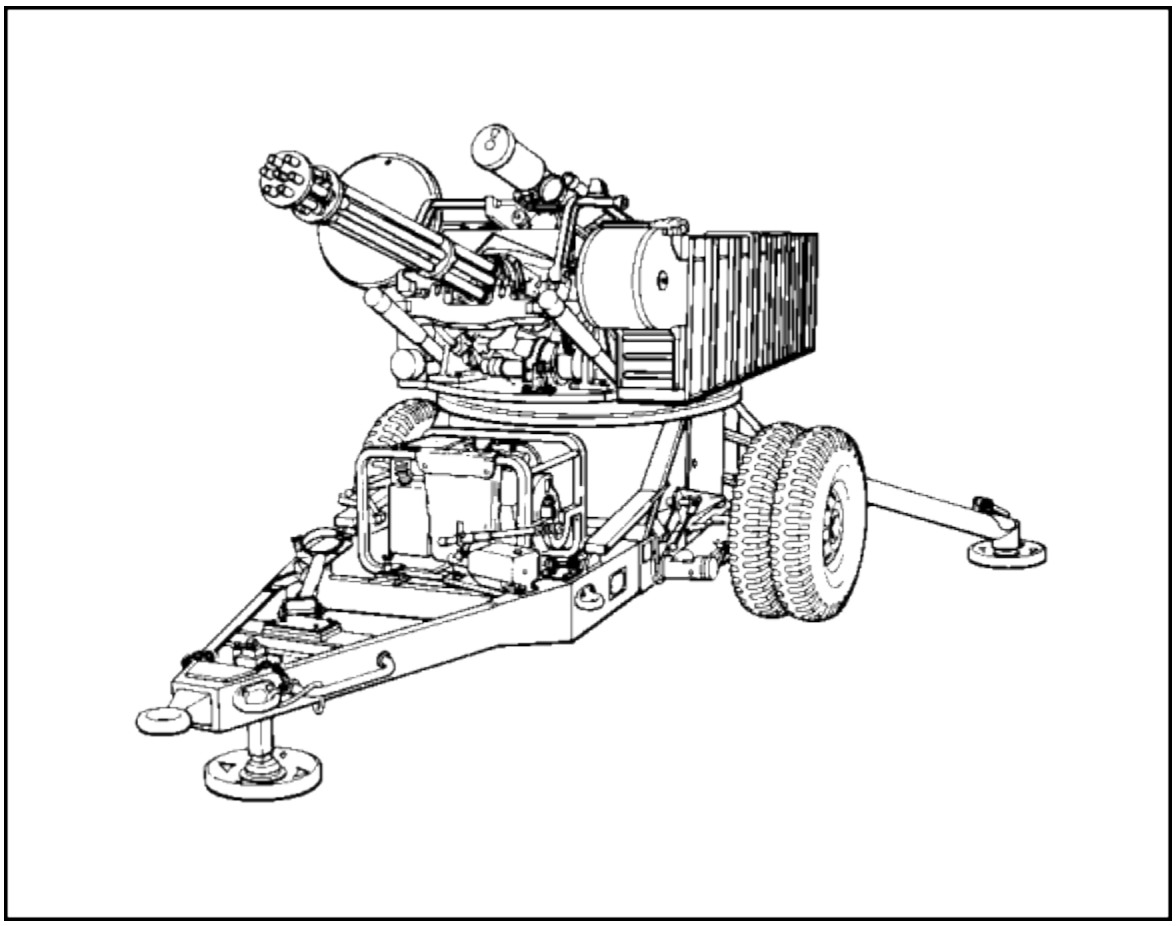


FIGURE 23. TOWED VULCAN.

VULCAN CHARACTERISTICS, SP AND TOWED

	Gun, AA, 20-mm; M163A1, SP	Gun, AA, 20-mm, M167A1, towed
WEIGHT AND DIMENSIONS		
Weight	27,542 lbs (12,493 kg)	3,490 lbs (1429 kg)
Length	172 in (436.9 cm)	186 in (472.4 cm)
Width	113 in (287.0 cm)	79 in (200.7 cm)
Height	115 in (292.1 cm)	81 in (205.7 cm)
MOBILITY		
Max speed-on road	40 mph (64.4 kmph)	45 mph (72.4 kmph)
Max speed-fording	4 mph (6.4 kmph)	2-3 mph (3.2-4.8 kmph)
Max speed-swimming	4 mph (6.4 kmph)	Cannot
Maximum water depth	*	**
Cruising range	275 mi (442.6 km)	300 mi (483 km)
Turning radius	12.8 ft (3.9 m)	29 ft (8.8 m)
AMMUNITION, 20-mm		
In weapon	1,100	500
Ready to load	1,000	
In boxes	Remainder of basic load	Remainder of basic load
CAPABILITIES (both versions)		
Rate of fire, high rate	3,000 rpm	
Low rate	1,000 rpm	
Burst limit, high rate	10, 30, 60, 100 rd	
Low rate	Gunner controlled	
Radar range	250-5,000 m (1 sq m target)	
Max effective range		
Air defense	1,200 m	
	2,200 m direct	
Ground	4,500 m indirect	

* The M163A1 is limited in its swim capability to small inland lakes and streams where the waves do not exceed 11in in height.
** The fording capability of the M167A1 is —
Fording depth w o APU - 39 in.
Fording dept w APU - 17 in.

FIGURE 24. VULCAN GUN SYSTEM CHARACTERISTICS.

System Operation. In a Vulcan engagement (Figure 25) the SL identifies the target as hostile. The gunner acquires the target visually and tracks it in the gyro lead computing sight (1); simultaneously, he energizes the ROR (2) which is aligned to the optical line of sight. The radar supplies target range and range-rate data which are processed to provide the proper superelevation and lead angles.

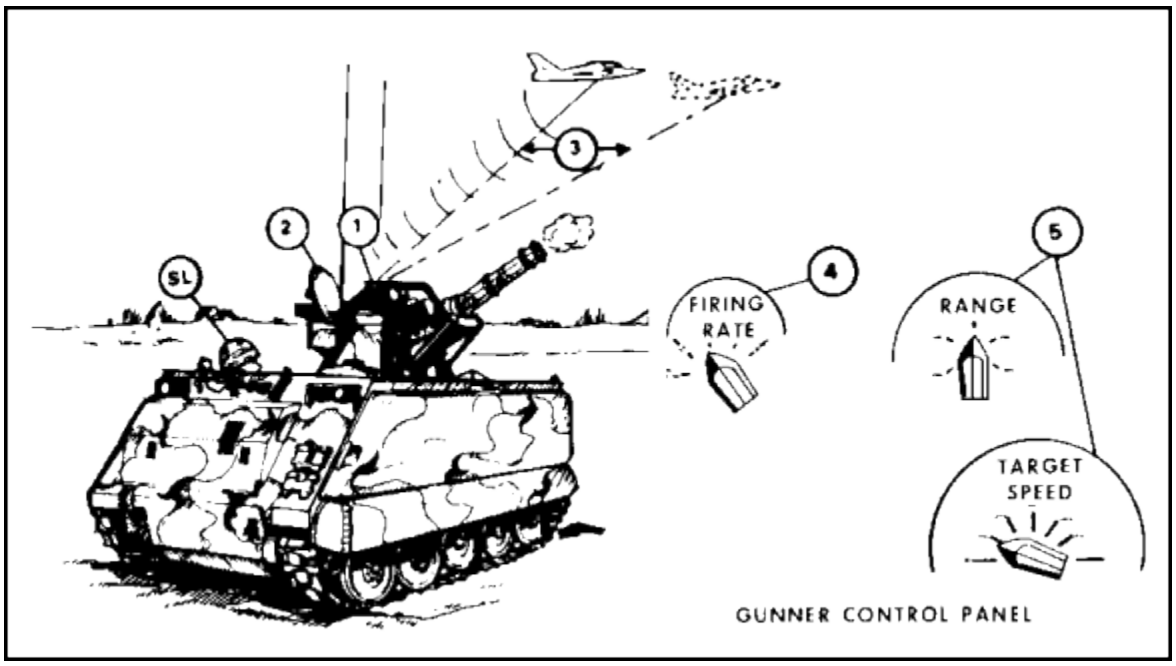


FIGURE 25. VULCAN SYSTEM OPERATION.

The gunner selects the firing rate of 1,000 rpm, with no burst limit, or 3,000 rpm with a burst limit of 10, 30, 60, or 100 rounds appropriate to the type of target (4). A ready-to-fire lamp lights, signaling to the gunner when to fire. When all conditions of firing have been met, the gunner fires. The normal mode of firing is the radar mode. An alternate mode is the manual mode, wherein the gunner estimates the target range and target speed, and sets these estimates on indicator dials on the gunner's control panel (5). The lead computing sight then computes the superelevation and lead angles based on these estimates. Functional characteristics, engagement, and firing procedures are the same for both the SP and the towed systems.

Redeye

The Redeye missile system (Figure 26) provides combat units with the capability of destroying very low- to low-altitude threat aircraft. Redeye is deployed throughout the combat area. It moves with the troops, providing continuous AD. The Redeye weapon consists of three major components: (1) the launch tube assembly, (2) the missile round, and (3) the BCU.

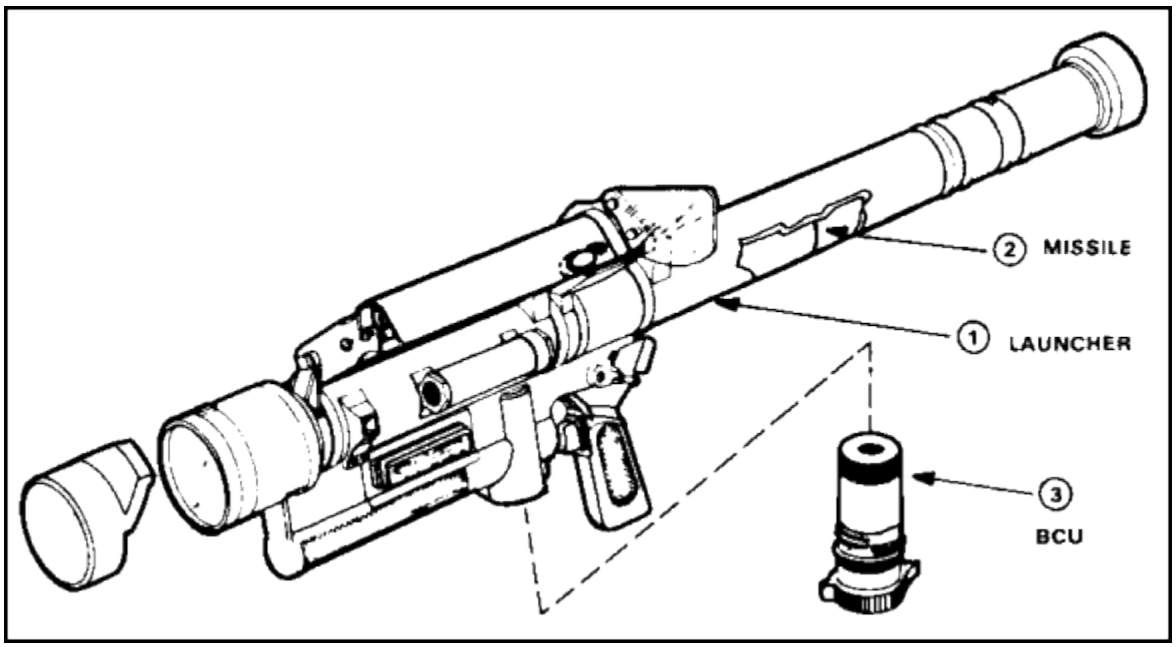


FIGURE 26. REDEYE MISSILE SYSTEM M41.

The missile, sealed within the launcher, is not removed in the field except by firing. After being replaced by the Stinger missile system, it is expected that Redeye will be in service for several years with Reserve and National Guard units. Redeye missile system characteristics are shown in Figure 27.

LAUNCHER			
	Weight of weapon	29 lbs	
	Length	49.7 in	
MISSILE			
	Type	Supersonic, surface-to-air	
	Weight	(18 lbs)	8.2 kg
	Diameter	(2.75 in)	19 cm
	Length	(47.5 in)	1.2 m
	Guidance	Passive IR homing and proportional navigation	
	Range	Greater than 1 km	
	Warhead	HE	
	Motor	Rocket, solid propellant, two-stage (ejector and sustainer)	
	Backblast safety zone	13 m	

FIGURE 27. REDEYE MISSILE SYSTEM CHARACTERISTICS.

System Operation. On sighting a hostile target, the gunner (1) tracks it visually in an open sight. At the same time he activates the missile guidance system (2). A buzzer (3) informs the gunner when the missile has acquired the target and is ready to fire. The gunner inserts superelevation and lead to the missile-target line of sight (4) and fires the missile. Upon firing, the ejector motor propels the missile (5) out of the launch tube. When the missile has cleared the launch tube muzzle by a distance sufficient

to protect the gunner from blast effects (5 to 9 meters), the sustainer motor fires (6) and propels the missile the rest of the way to the target (Figure 28).

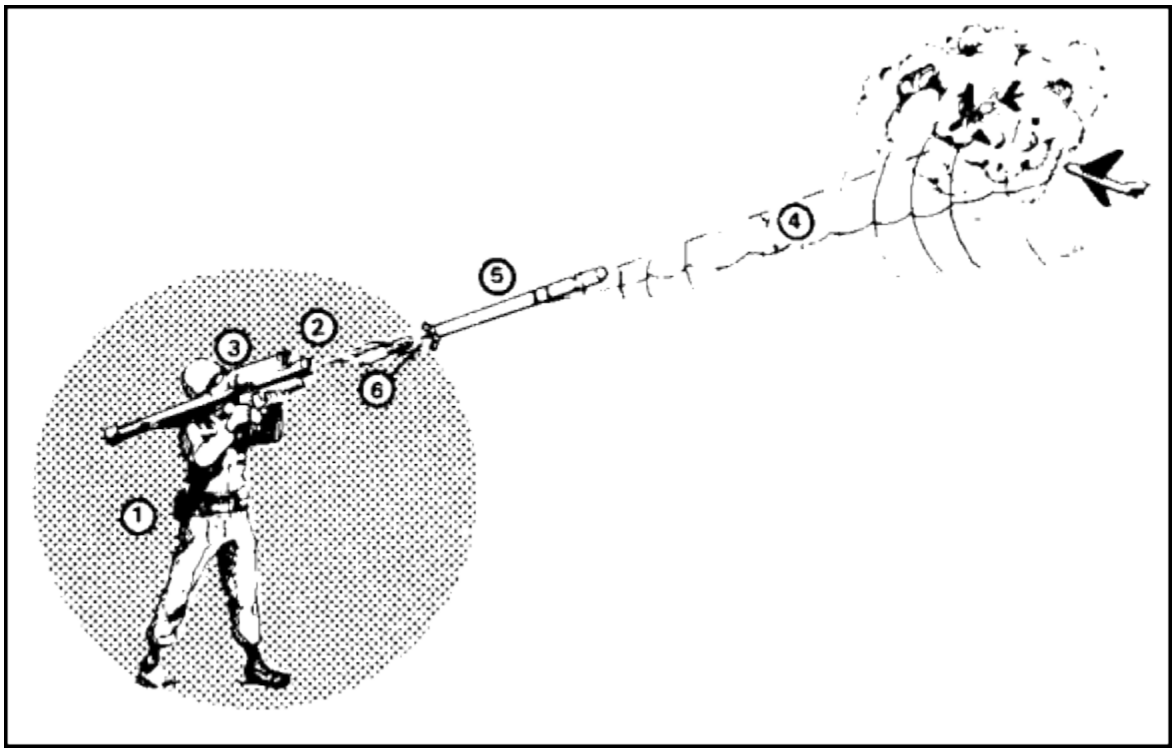


FIGURE 28. REDEYE MISSILE OPERATION.

Stinger

The Stinger (Figure 29) is a second generation MANPAD system. Stinger has an increased range and intercept capability over Redeye. Stinger will replace the Redeye weapon system in the 1980-1990 time frame.

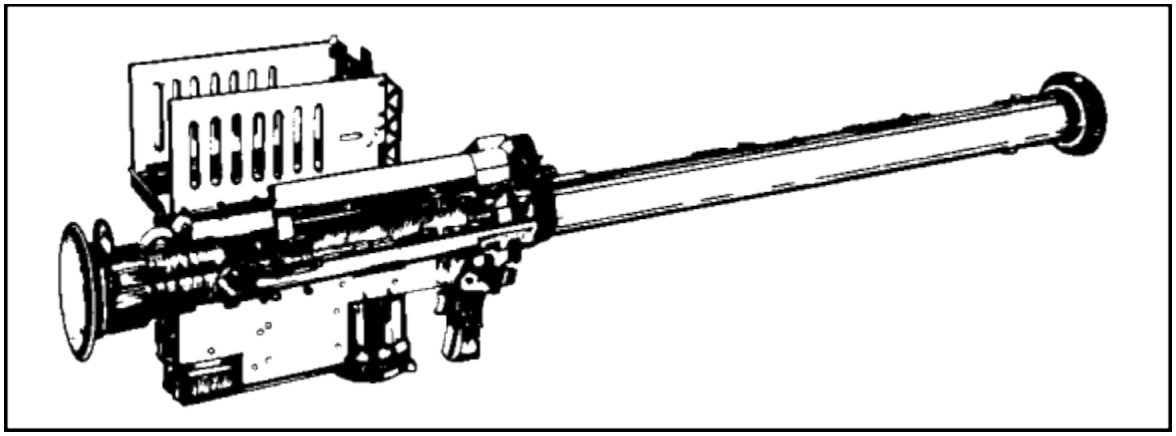


FIGURE 29. STINGER MISSILE SYSTEM.

The Stinger is a short-range, very low- to low-altitude, shoulder-fired weapon with IFF capabilities. It is easily deployed throughout the combat area and moves with the troops the same as Redeye. Stinger

is capable of engaging all aircraft operating at low level and different ordnance delivery speeds. The Stinger missile system characteristics are shown in Figure 30.

LAUNCHER		
	Weight of weapon	34.9 lbs
	Length	60 in
MISSILE	Type	Supersonic, surface-to-air
	Diameter	2.75 in
	Length	58 in
	Guidance	Passive IR homing and modified proportional navigation
	Range	Excess of 4 km
	Warhead	HE
	Motor	Rocket, solid propellant, two-stage (separable launch motor and dual-thrust flight motor)
	Backblast safety zone	50 m

FIGURE 30. STINGER MISSILE SYSTEM CHARACTERISTICS.

System Operation. When the target is visually detected, the gunner points the launcher toward the target. He sights over the sight assembly and then looks into the peep sight. He positions the target into the center of the range ring and challenges the target by pressing the IFF challenge switch. Depending upon the IFF response and the rules of engagement, the gunner begins tracking and ranging the target in the sight until visual identification is made. When the target is identified as hostile, the gunner activates his weapon by pressing the safety and actuator device.

He continues tracking the target and listens for an IR acquisition tone. If the signal is strong enough for seeker lock-on, the tone becomes steady. After the seeker acquires the target, the gunner presses and holds the uncaging switch and continues to track the target. The tone should remain constant, indicating to the gunner that the seeker is still locked onto the target. The gunner inserts superelevation and lead into the missile line of sight and fires the missile. When the missile clears the launch tube by a distance sufficient to protect the gunner from backblast (9 meters), the dual-thrust motor ignites and propels the missile toward the target.

Chaparral

The Chaparral weapon system is a highly mobile SAM system designed to counter the high-speed, low-altitude air threat to organizations and critical assets in the forward areas. Chaparral is fielded in the SP configuration only; however, the launching station is a complete, self-contained weapon system and may be separated from the carrier and operated in a ground-emplaced mode. Effective employment of the system depends upon visual target detection, tracking, and recognition. Chaparral is considered to be a fair-weather system. The system is air-portable by cargo aircraft. The launching station may be sling-lifted by helicopter when separated from the carrier. The M48 system is composed of three major elements: launching station, carrier, and Chaparral missiles. The Chaparral missile system characteristics are listed in Figure 31.

WEIGHT	M730 carrier, noncombat loaded	(14,222 lbs)	6,451 kg
	M730 carrier, combat loaded	(16,382 lbs)	7,431 kg
	M48A1 Chaparral, noncombat loaded	(22,936 lbs)	10,404 kg
	M48A1 Chaparral, combat loaded	(28,582 lbs)	12,965 kg
DIMENSIONS	Length	6.06 m	(19 ft, 10½ in)
	Width	2.69 m	(8 ft, 9 ¾ in)
	Height (wo cab cover)	1.93 m	(6 ft, 3 in)
PERFORMANCE	Maximum speed (highway)	(38 mph)	61 kmph
	(cross-country)	(10 mph)	16 kmph
	Cruising range (25 mph) 40 kmph)	(300 mi)	483 km
	Turning radius (pivot steering)	(14 ft)	4.3 m
	Maximum *fording depth*	*Unlimited*	
	Maximum forward slope	30°	
	Maximum emplacement slope	10°	
	Fuel capacity (diesel)	112 gal	
LAUNCHING STATION	Number of launch rails	4	
	Backblast safety zone	61 m	
	Traverse	360°	
	Elevation	-9° to 90°	
	Storage	8 missiles	
	Sight (type)	reflex	
MISSILE	Type	Supersonic, surface-to-air, aerial intercept	
	Weight	(190 lbs)	86 kg
	Length	(8.83)	2.9 m
	Diameter	(5 in)	12.7 cm
	Wing span	(24.8 in)	63 cm
	Guidance	Passive IR homing, proportional navigation, after optical aiming	
	Warhead	HE, fragmentation	
	Motor	Rocket, solid propellant, single-stage	
	Performance	Range beyond 5,000 m	
	Speed	Supersonic	

FIGURE 31. CHAPARRAL MISSILE SYSTEM CHARACTERISTICS.

The Chaparral missile system is enhanced with the addition of the FLIR modification. The FLIR enables the gunner to acquire, track, and engage targets during clear weather, at night, and during some adverse weather. Its introduction will change the engagement sequence, giving the gunner the authority to make identification and engagement decisions. The squad leader may override the gunner's decisions at any time.

System Operation. The squad leader (1) identifies the target (2) as hostile and commands the gunner to "Engage." The gunner (3) visually acquires the target, centers it in the reflex optical sight reticule, and establishes smooth tracking (4) until an audible IR signal tone is received. The gunner maintains the IR tone, evaluates target range, and makes his decision to fire. When all target engagement requirements are met and the hold-fire lamp is out, the gunner fires one or more missiles (5) as directed by the SL. At the time of firing, superelevation (6) is automatically inserted to ensure that proper missile flight is achieved (Figure 32).

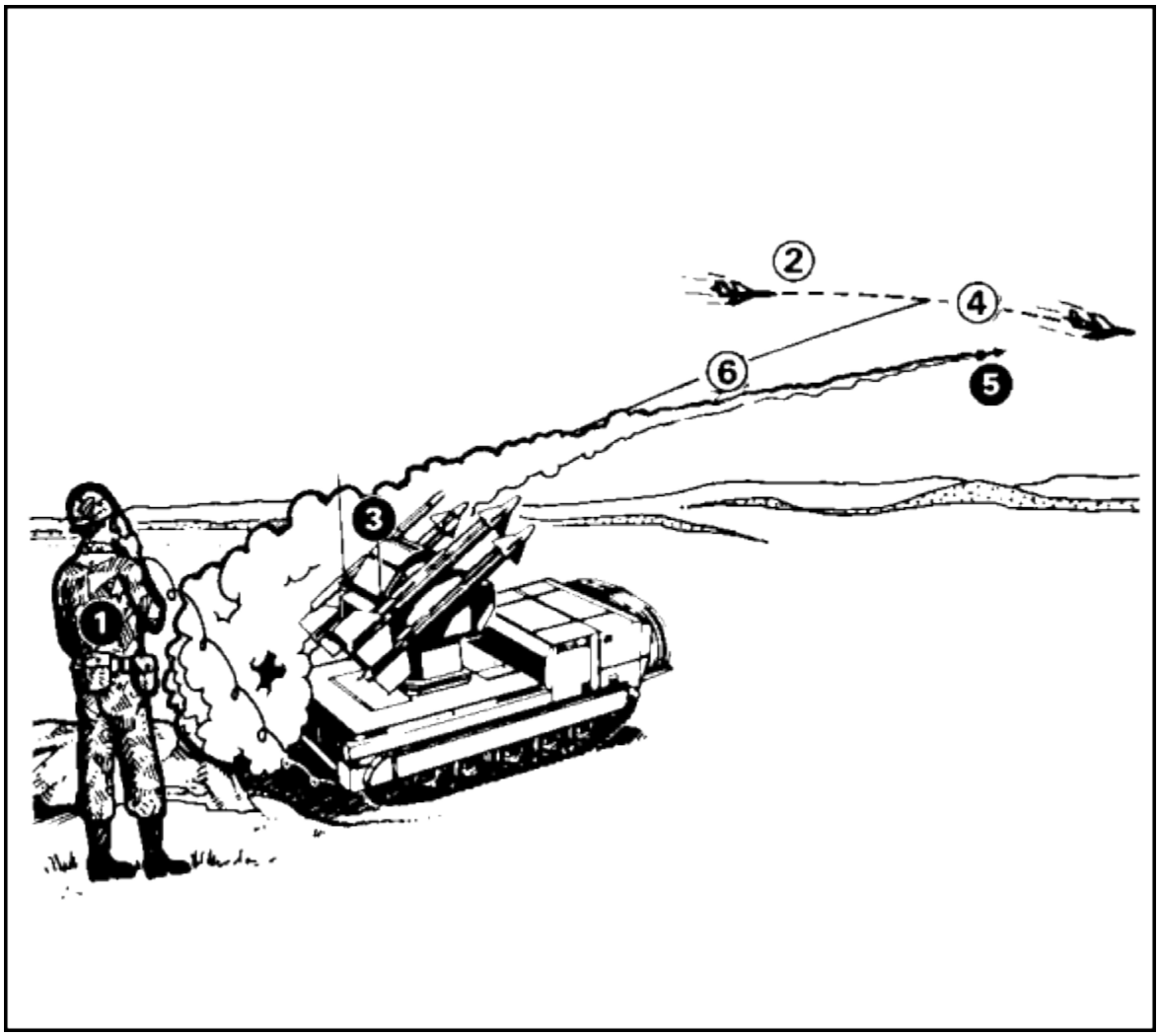


FIGURE 32. CHAPARRAL MISSILE OPERATION.

Learning Event 2:
HIMAD SYSTEMS

The category of HIMAD systems includes Hawk and Patriot. High- to medium-altitude missile systems are deployed throughout the theater to defend the theater and or corps commander's high-priority assets against hostile aircraft. They could also be assigned to corps or divisions, when available, to provide AD coverage for corps or division assets against high-speed aircraft.

Hawk

Hawk is a medium-range, all-weather AD guided missile system designed to provide AD coverage against very low- to medium-altitude air attack. Hawk organizations in the current Army force structure still call for battalions of either three or four firing batteries. Every Hawk firing battery consists of two AFPs and a battery headquarters. The Hawk unit organic to the corps ADA brigade is a 3x2 battalion. It consists of an HHB and three firing batteries, each of which has two AFPs. The Hawk unit organic to the theater army is a 4x2 battalion. It consists of an HHB and four firing batteries, each of which has two AFPs. All major components are trailer mounted giving the system a high degree of operational mobility. The system is air portable by cargo aircraft and can be sling lifted by helicopter. Figure 33 lists the Hawk system characteristics.

LAUNCHER			
	Weight		
	Less missiles	(4,610 lb)	2,091 kg
	With missiles	(8,813 lb)	3,998 kg
DIMENSIONS			
	Length (less missiles)		
	March order	(14 ft, 4 in)	4.4 meters
	Width (less missiles)		
	March order	(8 ft)	2.4 meters
	Height (less missiles)		
	March order	(7 ft, 8 in)	2.3 meters
	Full elevation	(12 ft)	3.7 meters
	Maximum fording depth	(30 in)	76 cm
	Maximum emplacement slope	10°	
MISSILE			
	Type	MIM-23B	
	Weight	(Approximately 1,400 lb)	635 kg
	Length	(16.5 ft)	5 meters
	Diameter	(1.17 ft)	36 cm
	Wing span	(4 ft)	1.2 meters
	Guidance	Semiactive homing	
	Warhead	H.E., blast, fragmentation	
	Motor	Dual-phase, solid propellant	
	Speed	Supersonic	

FIGURE 33. HAWK MISSILE SYSTEM CHARACTERISTICS.

Firing Battery System Description. Figure 34 shows how the Hawk missile system functions. The system detects targets using CWAR (1). Target data are also provided from outside the system through a data link from the battalion FDC. Target data are fed to the PCP (2). The PCP provides a means of target display, IFF challenge and display, and target assignment. The TCO in the PCP selects the target for engagement and assigns the target to his fire control section. The HIPIR (3) tracks the target and provides a reference signal to the missile. After launch, the missile homes on the target by continuously comparing the transmitted signal from the HIPIR with the reflected signal from the target. Using this information to make continuous adjustments in its course, the Hawk missile flies a proportional navigation course to the intercept point (4).

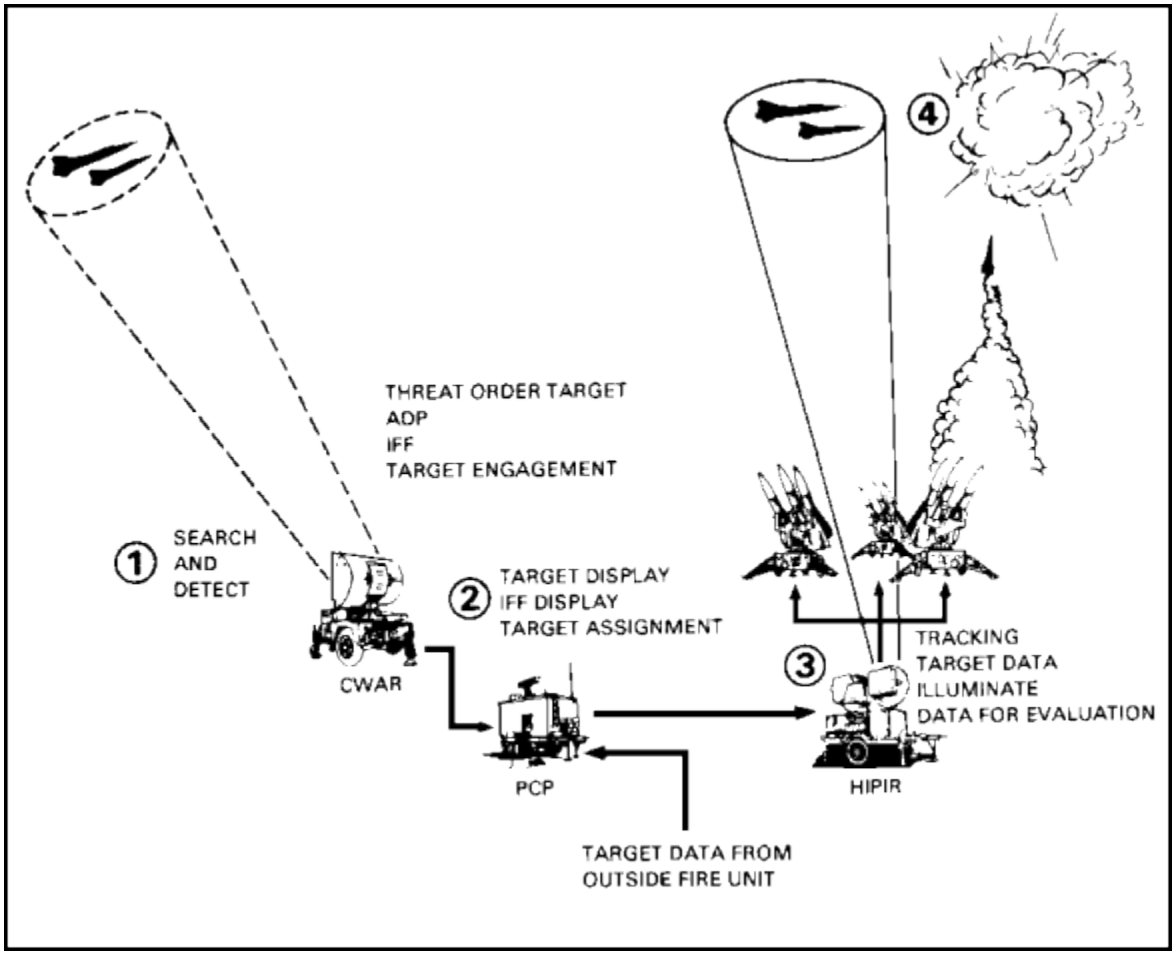


FIGURE 34. HAWK SYSTEM FUNCTIONING.

Patriot

The Patriot missile system is designed for maximum effectiveness against the air threat anticipated in the 1980s and beyond. The system has the role of very low- to very high-altitude AD of ground combat forces and critical assets. It is designed to replace US Mike Hercules and most of the Hawk missile systems. The Patriot system performs its mission with less tactical equipment, greater firepower, improved ECCM capability, 100 percent mobility, and simplified logistics and maintenance. The system requires fewer major end items of equipment and personnel than previous AD systems. Figure 35 lists the characteristics for the Patriot missile system.

LAUNCHER STATION	Weight	(85,547 lb) (w vehicle M983 and 4 msls)	38,803 kg
DIMENSIONS	Length	(54 ft, 11 in) (w vehicle)	16.8 m
	Width	(9 ft, 5 in)	2.9 m
	Height	(8 ft, 6 in) (w 4 msls)	2.6 m
	Maximum fording depth	(48 in)	1.2 m
	Maximum emplacement slope	10°	
	Radar set	Classified	
MISSILE	Type	MIM-104	
	Weight	(3,740 lb)	1,696 kg
	Length	(17 ft, 5 in)	5.3 m
	Diameter	(16 in)	40.6 cm
	Wing span	(34.3 in)	87 cm
	Guidance	Command guidance / TVM	
	Warhead	Classified	
	Motor	Classified	
	Speed	Classified	

FIGURE 35. PATRIOT MISSILE SYSTEM CHARACTERISTICS.

System Operation. Figure 36 shows the scheme of operation of a Patriot fire unit and the principal functions of each major item of equipment. The RS (1) covers the surveillance area and detects (2) all targets. RS data (3) on each target are processed by the ECS (4) WCC. Targets are then manually or automatically identified as unknown, friendly, or hostile. When a target is identified as hostile, it then is engaged either manually or automatically. Once engagement is initiated, the WCC determines which LS (5) will fire. The WCC communicates with the selected LS by means of VHF communications. Missiles from the selected LSD are then activated, data exchanged between the selected missile and the WCC (6), and the missile (7) is launched. It is acquired by the RS and a two-way data link (8) is established with the WCC, and then the target is acquired by the onboard missile seeker antenna (9). The target is then tracked via missile, while the two-way data link is maintained at an increased rate. The missile moves to the intercept point while the target is illuminated (10) by the RS. The missile proximity fuze is armed causing the activation of the warhead at the proper time.

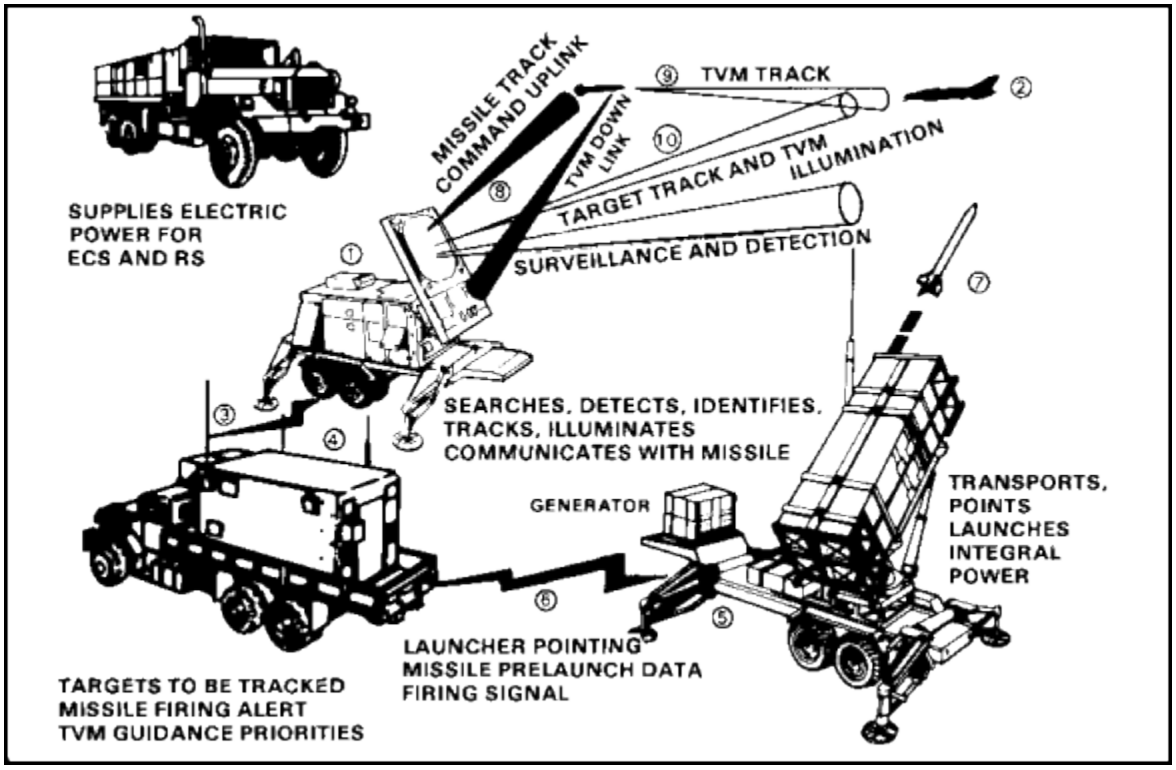


FIGURE 36. PATRIOT SYSTEM.

Learning Event 3:
COMMAND AND CONTROL AND ADA RADAR WARNING SYSTEMS

Long- and medium-range ADA weapons, such as Hawk and Patriot, operate within a command and control system that is tied in with higher level AD control facilities. This tie-in provides for the exchange of aircraft track information on, and direct assignment of, hostile aircraft for engagement by these weapons. Elements of the command and control system are established and employed at all levels from the brigade to the fire units. The use, requirements, and purposes of a command and control system are well established.

AN/TSQ-73 Command and Control System. The AN/TSQ-73 system is an electronic AD command and control system designed to provide essential tactical command to SAM firing units in defense against hostile aircraft. Specifically, the AN/TSQ-73 Missile Minder is a fifth generation AD command and control system developed to provide the AD commander with the resources necessary to effectively carry out his AD mission. Capable of operating at either battalion or brigade level, the mission of the AN/TSQ-73 is to furnish information for the command and control of individual fire units, coordinate the actions of subordinate systems, and provide an interface with other services and the US Army systems.

The key features of the AN/TSQ-73 are: two self-contained situation display consoles, radar interface equipment, ADP equipment, and communications equipment capable of providing automatically processed digital data communications and advanced voice communications.

The AN/TSQ-73 is a reliable, mobile, easily transportable, compact, and automated command control system. The extensive use of microelectronic digital circuitry to replace discrete, component digital elements and a number of analog elements resulted in size, weight, and power reductions that enable the entire system to be housed in single mobile shelter. The shelter is designed to withstand worldwide environmental conditions. Due to the modular design of the system equipment, the baseline AN/TSQ-73 is easily expanded for increased AD missions or for modified roles and missions. The system is programmable and compatible with a wide range of radars and other command and control systems. It can be deployed anywhere in the world. Featuring built-in test equipment and fault detection, the AN/TSQ-73 system maintenance is accomplished by replacing defective parts. Computer-controlled diagnostic programs and in-shelter spare parts are used to maintain a short Mean-Time-to-Repair. All equipment used in the system is designed and constructed to permit access to all modules without removal of any other module. Short downtime and high reliability enable the AN/TSQ-073 to meet stringent availability standards essential to AD control systems. The AN/TSQ-73 is self-transportable when the shelter is mounted on a cargo truck. It can also be transported by ship, rail, or air, and is skid mounted for transport by helicopter.

The AN/TSQ-73 system can be operated at either battalion or brigade level. The battalion system provides control and coordination of individual fire units. The group system acts as overall activity director, coordinating the actions of subordinate battalion systems, and providing AN/TSQ-73 interface with other services and US Army systems. A battalion system can handle 24 individual fire units and a group system is capable of coordinating the actions of 48 individual fire units. In the absence of a brigade system, battalion AN/TSQ-73 assumes brigade functions as a master battalion.

Display Consoles. Two display consoles provide the operator with a position referenced display of situation data and the capability to enter, modify, and delete information in the ADP display files. The consoles can be operated in five different modes, each selectable by the operator. These are tracking, tactical, tracking and tactical (combined), monitor, and test. The data display group provides unit fire status information, missile counts, weapon status, alert conditions, and system fault conditions. Essential data are displayed enabling the operator to make fast, accurate decisions based on up-to-second displayed information concerning track positions, weapon positions, map, jam strobes, velocity vectors, safe corridors, pairing lines, defended areas, and points.

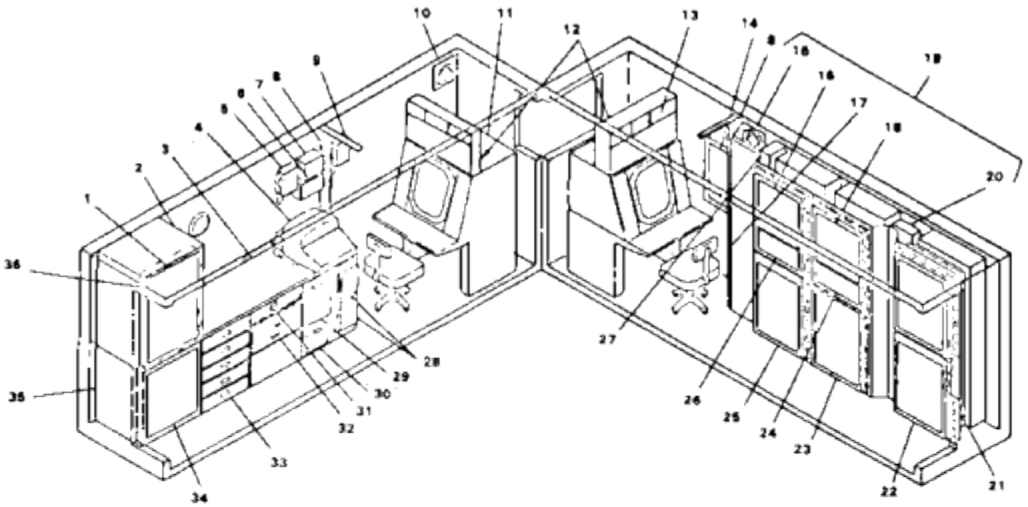
RIE. The RIE accepts information from local radar and IFF equipment, and processes it for use by the ADP and display equipment. The RIE obtains radar target and sweep position data, normalized radar data, video target, and internally digitized data. An IFF beacon decoder rapidly identifies and tracks any aircraft which are undetectable by the primary radar. A target processor coordinates target stops and starts to determine azimuth and range reports, updates continuing target reports, and verifies valid targets.

ADP Equipment. Overall control and coordination of the system functions are performed by the ADP equipment. It provides data processing for radar signals, simulation routines, communications, display data for the consoles, and mechanizes operator initiated commands. The ADP equipment interfaces with all AN/TSQ-73 subsystems except voice communications, and provides them with necessary interface information. AN/TSQ-73 data processing is a real-time function permitting validation of incoming radar target data to determine threat conditions and assigning the appropriate SAM to the

hostile threat. The data processor continuously and automatically updates the status and location of AD forces, and informs AD units of status, condition, and activity changes.

Communications Equipment. The communications equipment provides voice and data links between the ADP and console operators, and between external systems and subscribers. Voice communications and data communications are two independent functions common to the communications patch panel for line only or equipment only monitoring. Voice communications are by a standard semiautomatic telephone switching system. The data communications function provides an interface between the ADP and the remote site data system.

The arrangement of the equipment in the AN/TSQ-73 is shown in Figure 37.



1. Voice comm central panel
2. Patch panel
3. Maintenance bench
4. Keyboard printer
5. Voice comm station
6. Environmental control panel
7. Pressure sensing module control
8. Blackout curtain
9. Voice comm station
10. Blower (ducting removed)
11. Display console assembly
12. Status display panel
13. Display console assembly
14. Escape hatch
15. Blower
16. Radar interface equipment panel II
17. Radar interface equipment panel I
18. ADP status and control panel
19. Equipment rack
20. ADP interface panel
21. ADP external interface panel
22. Equipment rack 3
23. Equipment rack 2
24. Data comm panel
25. Equipment rack 1
26. Radar simulator panel
27. Radar interface panel
28. Magnetic tape unit
29. Module test set
30. Storage drawer
31. Oscilloscope
32. Safe
33. Storage drawers (5 places)
34. Main power panel
35. Main power enclosure
36. Voice comm central unit

FIGURE 37. AN/TSQ-73 SHELTER AND EQUIPMENT ARRANGEMENT.

FAAR

The FAAR system (radar system AN/MPQ-49) (Figure 38) is a complete self-contained acquisition radar system consisting of radar set AN/TPQ-32, the M561 Gamma Goat, and a 5-kilowatt generator set mounted in a cargo trailer.

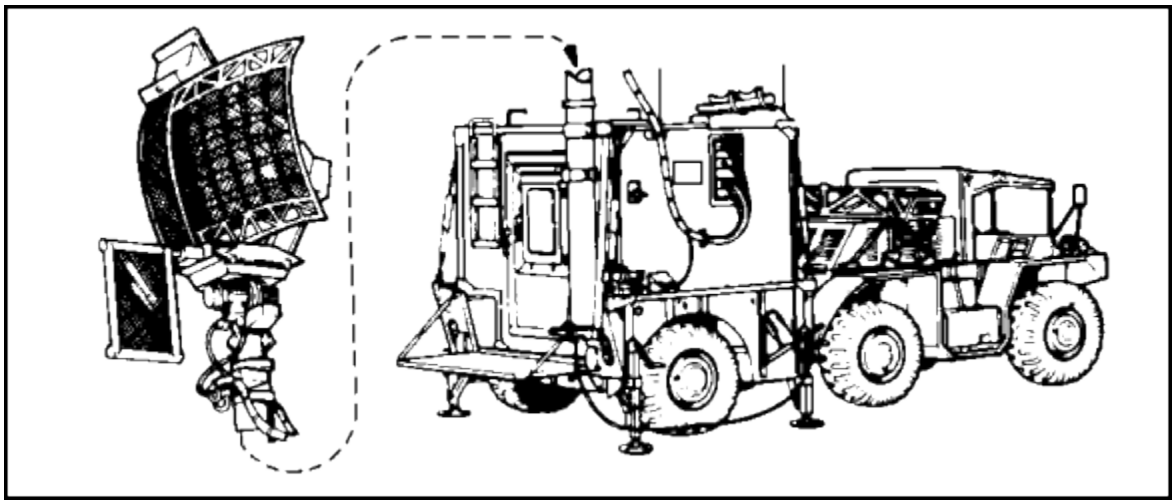


FIGURE 38. FAAR SYSTEM.

The FAAR is relatively lightweight (6 tons), mobile, and capable of being deployed as required to support Chaparral, Vulcan, Redeye and Stinger. The system is air transportable and can be lifted and moved by CH-47 or larger helicopters. The FAAR system aids in denying enemy aircraft undetectable access to forward combat areas. The FAAR provides relative position data for each aircraft detected, in terms of distance (range) and direction (azimuth). Through use of the AN/TPX-50 IFF system, FAAR also provides tentative target identification.

While FAAR is highly susceptible to damage from small arms and field artillery fire, the system can be operated from a protected spot up to 50 meters (150 feet) from the radar system and antenna by removing and remoting the control-indicator assembly. The FAAR can detect targets at ranges out to 20 kilometers.

Practice Exercise
Lesson 2

Instructions The following items will test your understanding of the material covered in this lesson. There is only one correct answer for each item. When you have completed the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, review that part of the lesson which contains the portion involved.

1. Which of the following is a characteristic of the Hawk system?

   - ○ A. It has an automated diagnostic troubleshooting and module replacement maintenance system.
   - ○ B. All major components are trailer mounted, giving it a degree of operational mobility.
   - ○ C. It is designed to provide low- to high-altitude defense against air attack.
   - ○ D. It is air portable only by helicopters.

2. What is the AN/TSQ-73 system?

   - ○ A. An improved continuous-wave radar.
   - ○ B. An electronic AD command and control system.
   - ○ C. A target alerting data display system.
   - ○ D. An alert nerve center and tracking system, model Q-73.

3. Which provides the best option for providing adequate AD for US forces?

   - ○ A. The Patriot system, which can destroy aircraft from very high to low altitudes.
   - ○ B. The Vulcan gun system, which can move with the forward elements.
   - ○ C. The Stinger missile system, which is man-portable and can easily be transported wherever soldiers go.
   - ○ D. A mix of complementary systems, which are highly effective when employed in sufficient numbers.

4. On the Patriot missile system, once the missile is launched and the target is acquired by the onboard missile seeker antenna it is then tracked via--

   - ○ A. the missile.
   - ○ B. the sight.
   - ○ C. manual control.
   - ○ D. data link.

5. In which configuration is the Hawk missile system fielded?

- A. Towed and SP.
- B. SP only.
- C. Trailer-mounted.
- D. Truck-mounted.

6. What is the purpose of the FAAR system?

- A. To provide alert warning for Chaparral, Vulcan, Redeye, and Stinger.
- B. To provide forward antiaircraft response control.
- C. To control final aircraft attrition response.
- D. To provide a forward automated command and control center.

7. The Redeye weapon system consists of three major components: launcher, missile and BCU. Is the missile to be separated from the launcher in the field? If so, for what purpose?

- A. This missile should be removed for quarterly service and lubrication of the variable control surfaces.
- B. The missile should be removed annually to perform required checks of the missile battery section.
- C. The missile should be removed only after a misfire.
- D. The missile is sealed within the launcher, and it is not removed in the field except by firing.

LESSON 2

PRACTICE EXERCISE ANSWERS

1. Which of the following is a characteristic of the Hawk system?

a. It has an automated diagnostic troubleshooting and module replacement maintenance system.
b. All major components are trailer mounted, giving it a degree of operational mobility.
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d. It is air portable only by helicopters.

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c. The missile should be removed only after a misfire.
d. The missile is sealed within the launcher, and it is not removed in the field except by firing.

LESSON 3

ADA OPERATIONS

TASK

This lesson does not specifically relate to any enlisted or officer tasks, but provides general information on the basic principles of employment prioritization and control of AD assets.

CONDITIONS

Use only this lesson material to complete the examination.

STANDARDS

You must attain a grade of 70 percent or more on the examination to receive credit for this subcourse.

REFERENCES

The following references are sources for additional information. You do not need them to complete this lesson.

FM 44-1
FM 44-2
FM 44-3
FM 44-15
FM 44-15-1
FM 44-90
FM 44-90-1

Learning Event 1:
PLANNING ADA OPERATIONS

Air superiority in the AirLand battle is projected to be limited, applying to specific areas for short periods of time. The impact of this to the ground commander is substantial. In many cases, operations will be conducted without the benefit of a secure air cover. Providing effective ADA protection to our forces is more critical now to force survivability than ever before. The keys to effective AD are economical ADA force allocation, sound defense planning, and proper employment of ADA resources on the AirLand battlefield.

Planning both SHORAD and HIMAD operations relies on fundamental military problem-solving techniques. Forces must be allocated to defend selected, prioritized assets; defenses must be planned; and as the tactical situation changes, modifications must be made to those defenses. To plan and conduct ADA operations on the AirLand battlefield, commanders should follow an orderly process that considers the following steps in some form:

- Recognizing and defining the problem.
- Gathering information.

- Developing alternative solutions.
- Evaluating alternatives.
- Selecting the best solution to the problem.

To resolve each problem related to ADA support of AirLand battle operations, every step of the problem-solving process should be considered. In some cases, these steps will be completed informally and decisions made in a matter of minutes. However, when the tactical situation permits, the process should be carefully and thoroughly completed to ensure maximum effectiveness of the support provided.

Learning Event 2:
ADA MISSIONS AND RESPONSIBILITIES

Specific responsibilities and relationships between supported units and supporting ADA units are defined in the assignments of tactical missions. The assignment of a specific mission is inherent to command, and follows the command chain except in those situations where an ADA unit is placed in attachment or in an OPCON status. In that special situation, the commander exercising OPCON assigns the ADA unit its mission.

It is important to note that there is no "normal" tactical mission for any ADA unit. Any tactical mission is possible and may be assigned for any ADA unit based upon the situation and the evaluation by the ADA commander.

ADA Standard Tactical Missions

Standard tactical missions apply to all types of ADA units, assign mutual responsibilities, and define specific relationships between supported and supporting units. The "standard" in standard tactical missions does not imply these missions will always be assigned, but rather that they are applicable to any type ADA unit. The use of standard tactical missions provides consistency in the rules and relationships between the ADA unit and the supported unit. However, assignment of one of these tactical missions does not negate ADA unit responsibility for its own administrative and logistical support. In some cases, certain logistical support may be provided by the supported unit to assist the ADA unit in accomplishing the mission. Such support depends upon the tactical situation and must be prearranged between the staffs of both units.

The four ADA standard tactical missions are: GS, GS-R, R, and DS.

GS. An ADA unit with a GS mission provides support for the force as a whole. It is not committed to any specific element of the supported force.

GS-R. An ADA unit with a GS-R mission provides coverage for the force as a whole and augments the coverage of another ADA unit. GS-R units are not committed to any specific element of the force.

R. An ADA unit with an R mission augments the coverage of another ADA unit.

DS. An ADA unit with a DS mission provides dedicated AD for a specific element of the force that does not have dedicated ADA. The DS unit is committed to that specific element of the force.

The specific relationships and responsibilities formed by, and inherent to, the ADA standard tactical missions are shown in Figure 39.

	GENERAL SUPPORT (GS)	GENERAL SUPPORT-REINFORCING (GS-R)	REINFORCING (R)	DIRECT SUPPORT (DS)
Who establishes AD priorities?	The supported commander.	(1) The supported commander. (2) The supported commander through the reinforced ADA commander.	The supported commander through the reinforced ADA commander.	The supported commander.
Who locates the ADA unit?[1]	The commander assigning the mission in coordination with the supported force ground commander.	The commander assigning the mission in coordination with the supported force ground commander.	The reinforced ADA commander in coordination with the supported force ground commander.	The DS ADA commander with approval of the local ground commander.
Who positions ADA fire units?[2]	ADA fire unit commanders in coordination with the local ground commander.	ADA fire unit commanders in coordination with the reinforced ADA unit commander and the local ground commander.	ADA fire unit commanders with approval of the reinforced ADA unit commander and the local ground commander.	ADA fire unit commanders with approval of the local ground commander.
With whom to establish liaison?	As required by commander assigning GS mission.	As required, but including the reinforced ADA commander.	As required, but including the reinforced ADA commander.	Supported unit commander.
With whom to establish communications?	As required by commander assigning GS mission.	As required, but including the reinforced ADA unit.	As required, but including the reinforced ADA unit.	Supported unit.

Notes:

1. The terms "locates" and "locating" specify the establishment of a broad operating area (commonly, a "goose egg").

2. The terms "positions" and "positioning" specify the selection of an exact point within the operating area. (Although not addressed here, the terms "sites" and "siting" specify the placement of the individual items of equipment on selection spots within the platoon.)

FIGURE 39. SUPPORT RELATIONSHIPS AND RESPONSIBILITIES (ADA STANDARD TACTICAL MISSIONS).

Learning Event 3:
CLASSES AND TYPES OF AD

Classes of AD

Active AD. Active AD is direct action taken to destroy or reduce the effectiveness of enemy air operations. It includes the use of aircraft, surface-to-air weapon systems, ECM, and weapons other than ADA used in an AD role.

Passive AD. Passive AD is defined as all measures other than active AD taken to minimize the effects of hostile air action. These include, but are not restricted to, the use of cover, concealment, camouflage, dispersion, and protective construction.

Types of AD

ADA systems may be allocated to provide two types of AD: area defense and point defense.

Area Defense. Area defense is a posture designed for the defense of a broad area. Airborne AD resources have primary responsibility for providing area ADs because of their flexibility, range, mobility, and reusability. In an area defense, no particular asset(s) receives priority of defense.

A belt defense is a specialized application of area AD found in NATO where ADA resources are deployed in a linear configuration to provide early attrition of the enemy as he attempts penetration to rear areas. This type of defense may be necessary to provide the best coverage of the ground commander's priorities. No particular asset(s) receives priority of defense in a belt defense. However, fire units are normally positioned within a belt to provide the best possible coverage of the ground commander's priorities while maintaining the belt defense. Belt defenses inherently detract from the ability of participating ADA forces to explicitly support the primary Army function of conducting prompt and sustained AirLand battle operations. With limited ADA resources, spreading fire units in a thin line inhibits the ability to mass ADA fires. Belt defenses are vulnerable at the flanks to fly-around tactics.

Point Defense. The point AD, also known as critical asset defense, is a defense concentrated on a limited area normally in the defense of the vital elements of a force and or the vital installations of the rear area. A point defense is characterized by priority of defense being given to specific assets. These assets can either be mobile or static, and they can be either organizations or installations. Even though the ADA weapons involved in a point defense may provide AD coverage over a wide geographical area, the term "area defense" does not apply because specific assets are to be defended in priority. The type of AD selected by the ADA commander to protect the supported commander's priorities is based on providing the greatest degree of protection to those assets under the constraints of available forces and the relative priority of each asset.

Learning Event 4:
ADA SYSTEM OPERATIONS

An additional consideration for the proper use of ADA forces is the type of ADA system that is to be employed in the defense. SHORAD systems are usually allocated to provide point defense to maneuver elements and other high-value assets in both forward and rear areas. SHORAD systems include SHORAD gun and missile systems, to include MANPAD systems. SHORAD units may be assigned or attached to corps and ADA brigades. In addition, each division has an organic SHORAD battalion and each armored cavalry regiment has an organic SHORAD battery. HIMAD systems are deployed throughout the area of operations. Their employment is based on the needs of the force commander to which they are assigned or attached. This may result in HIMAD employment in both

area and point defenses. For point defenses, priorities may include both specified organizations and critical facilities. HIMAD also complements SHORAD protection and vice versa.

Offensive Operations

To provide sound AD guidance, the ADA commander must understand the fundamentals of offensive, defensive, and retrograde operations. Regardless of the type of operation, ADA assets are never held in reserve. While ADA will normally defend a variety of assets in any offensive operation, the top priority for AD will most frequently be given to the attacking maneuver elements designated as the main effort. When a maneuver brigade is designated as an AD priority by the division commander, it should be supported by at least a battery-size ADA element. As a general rule, a composite task force of ADA gun and missile systems is required for effective protection. Offensive operations on the modern battlefield will be extremely fluid and characterized by frequent, rapid change. ADA elements can expect to support operations characterized by rapid transition from defense, to the offense, to exploitation. Additionally, simultaneous, deep-strike operations and rear area battles will be conducted. Frequent, rapid changes in direction and location of the main effort and night combat must be anticipated. Each situation must be considered from the outset of the operation in determining the composition and employment of the supporting ADA force.

Defensive Operations

The immediate purpose of any defense is to cause an enemy attack to fail; however, an underlying purpose of all defensive operations is to create the opportunity to initiate offensive operations. All activities of the defense, to include AD, must contribute to that end. Corps, divisions, and sister services will organize and fight a synchronized defensive battle within a framework that consists of five elements:

- A deep battle operation in the area of influence to create windows of opportunity for decisive action against leading enemy echelons.
- A covering force operation to support the main effort by providing forward security.
- A main effort in the MBA where forces are positioned to conduct the decisive defensive battle.
- Rear area combat operations to defend vital rear area assets such as lines of communications, support areas, command and control, and long-range fire support.
- Reserve operations in the MBA or in the covering force area to support the main effort.

There is no single technique for defense prescribed by Army doctrine; therefore, ADA forces must be allocated to support any of several combinations of static and dynamic defenses. In its static forms, the defense is oriented on the retention of terrain through the use of firepower from fixed positions. For the defense to succeed, these fixed positions require protection from air attack.

The dynamic forms of the defense focus primarily on the enemy and depend upon maneuver and fire to destroy the enemy force. In this technique, the maneuver units are usually established as priority assets for AD. Corps, divisions, brigades, and battalions will normally combine static and dynamic forms in developing and executing defensive operations. Supporting ADA commanders must then allocate ADA

resources to maneuver elements, fixed firepower positions, reserve forces, command and control facilities, and logistical elements in priority as determined by the supported commander.

Retrograde Operations

A retrograde operation is an organized movement to the rear or away from the enemy. FM 100-5 discusses the three types of retrograde operations: the delay, the withdrawal, and the retirement. Each type of retrograde operation is characterized by difficulty of execution and risk.

Delay. A delay operation is conducted when there are insufficient forces to attack or defend, or when the defensive plan requires drawing the attacker into a vulnerable position. Delay operations are conducted by withdrawing to successive battle positions each time the enemy deploys for attack, thereby gaining time for reestablishment of the defense. In a delay, ADA resources are frequently allocated to protect elements of the reserve, CPs, FARPs, and maneuver choke points, such as bridges and defiles. These assets are listed as AD priorities in the supported force OPORD as determined by the commander.

Withdrawal. In the withdrawal, friendly forces voluntarily disengage from the enemy so that all or part of their force is repositioned by the commander. ADA forces are usually allocated to protect the same type assets as in the delay with special priority given to command and control facilities and reserves, assets which are vital to the execution of a successful withdrawal.

Retirement. A retirement is an administrative movement to the rear by a force that is not in contact with the enemy. The allocation of AD forces in a retirement depends upon the specific tactical situation dictating the operation. Before any ADA is used on the battlefield, AD priorities are established. To assist commanders in this task, a step-by-step, decision-making process was developed. The product of the decision-making process is a prioritized list of selected force assets to be defended by the supporting ADA commander. Development of these ADA priorities is the basis for planning effective AD to meet the needs of the supported commander within the constraints presented by the limited number of available ADA resources.

Learning Event 5:
DESIGNATION OF AD PRIORITIES

The Decision-Making Process

Before any ADA is used on the battlefield, AD priorities are established. To assist commanders in this task, a step-by-step, decision-making process was developed. When this process is followed by the supported commander in close coordinating with the ADA commander, the degree of support afforded by ADA resources is optimized. The product of the decision-making process is a prioritized list of selected force assets to be defended by the supporting ADA commander. Development of these ADA priorities is the basis for planning effective AD to meet the needs of the supported commander within the constraints presented by the limited number of available ADA resources.

Development of AD Priorities

The first step of the decision-making process is conducted by the supported commander during his estimate of the situation. As he generates courses of action and evaluates his assets, he determines which of these assets require ADA protection. This determination is made by evaluating each asset for criticality, vulnerability, recuperability, and threat.

Criticality. Criticality is the degree to which the asset is essential to mission accomplishment. Assets are categorized in priority as those which, if damaged--

- Are capable of preventing the execution of the plan of action.
- Will cause immediate and serious interference with the execution of the plan of action.
- Can ultimately cause serious interference with the execution of the plan of action.
- Might cause limited interference with the execution of the plan of action.

Vulnerability. Vulnerability is the degree to which the asset can survive on the battlefield. Consideration is given to the asset's hardness, its specific mission in the overall operation, the degree to which the asset can disperse or displace to another position, the degree to which it can provide its own AD, and the amount of protection afforded by passive AD measures.

Recuperability. Recuperability is the degree to which the asset can recover from inflicted damage in terms of time, equipment, and available manpower to again perform its mission.

Threat. The probability of an asset being targeted for attack by enemy air must be assessed if economical allocation of ADA resources is to be achieved. Targeting information provided by intelligence estimates, past enemy attack methods, and enemy doctrine are all useful in determining which assets require active AD protection.

Impact of the AirLand Battle on AD Priorities

The nature of combat in the AirLand battle requires commanders to expand the scope of consideration in determining the need for providing AD protection to any asset. Formerly, combat efforts focused on winning the fight only in the MBA. The extension of the battlefield in depth, time, and resources to include a deep battle, close-in battle, and rear area protection forces commanders to redefine priorities for AD to include all three battles. Assets that were formerly seen as most vital to main battle operations may not be so vital to the deep battle or to the rear area battle. Conversely, commanders must now consider certain type assets that were formerly not so vital to main battle operations as being high-priority assets for the deep attack and for the rear area battle.

In determining the need for providing active AD protection to any asset, commanders should consider certain characteristics which make that asset a lucrative threat target. Since both sides recognize the relationship of winning the deep attack to the outcome of the conflict, targeting strategies emphasize the early destruction of these assets which contribute the most to deep attack. Some characteristics of deep attack assets which provide the means for the commander to measure the need for AD protection include--

- Contribution the asset makes to the execution and cohesion of the defense or to the momentum of attacking units in the offense.
- Location on the battlefield where the asset makes its greatest contribution to the integrity of the second echelon forces as they prepare to join the battle.
- Effect at the FLOT, resulting from destruction of the asset at its present location.
- Threat which the asset poses to enemy air operations which are vital to their deep attack capability.
- Probability that the asset has been targeted by threat aircraft.

Based on these considerations, there are times when close-combat elements will use self and passive AD measures while assets such as corps artillery units, Army aviation FARPs, DIVARTY, and critical nuclear delivery units are given priority for active AD protection. Intelligence acquisition assets, command and control facilities, and specific weapon systems which are vital to deep attack must be given careful consideration by the commander establishing AD priorities. Failure to do so may result in the degradation of our force's ability to conduct the deep attack. In the projected scenario of the AirLand battle, this could lead to defeat.

Learning Event 6:
DEFENSE PLANNING

One of the major challenges faced by commanders is the proper use of the limited number of AD resources for the defense of critical forces and assets in the AirLand battle. AD of the AirLand battlefield must be properly planned so as to achieve a balance between defense effectiveness and economy of force. Two factors which impact directly on this problem are the inability of existing ADA resources to provide adequate AD protection to all the vital assets and the lack of adequate defense planning frequently provided to those defenses. Proper defense planning is a command responsibility which begins with the establishment of AD priorities and follows a sequential process of the following phases:

- Analysis.
- Defense design.
- Evaluation of alternatives.
- Implementation.

It is important to note that defense design, which considers employment guidelines and principles, is only one phase of the defense planning process and must be preceded by a formal or informal analysis. It is not the role of doctrine to dictate specific defenses for specific type assets. These will vary with the changing factors of each tactical situation. The following information provides the commander with the basic framework from which to conduct effective defense planning in any tactical situation.

Analysis Phase

Following the establishment of AD priorities, the ADA commander begins the sequential process of planning the ADs to protect those assets. Each AD must be planned to fit the present and projected tactical situation. Prior to initiating any operation on the battlefield, the ADA commander must conduct an estimate of the situation in which each of the factors of METT-T are considered. The product of this analysis phase is a recommended initial allocation of ADA assets to defend the prioritized assets of the supported force commander. This initial allocation is refined throughout the other phases of defense planning.

Mission. Analysis of the mission must consider the intent of the supported operation, essential specified and implied tasks to be performed, the degree of risk acceptable to the ADA unit, constraints or limitations imposed on ADA fires, probable follow-on operations, and the number and type of assets prioritized by the supported force commander. The ADA commander analyzes the mission to determine the most effective allocation of ADA resources to support the overall operation.

Enemy. An analysis of the enemy forces likely to be encountered is also critical to planning an effective AD. Because of the wide variety of options normally available to threat forces for the air attack of a friendly asset as compared to the ADA forces available to defend it, AD planners must plan the defense of a prioritized asset to counter the most likely threat against that target. Factors that must be considered are the type aircraft most likely to be used against the asset, most probable avenue of approach, threat attack tactics, probable ordnance, and likely ordnance release points. The availability of such intelligence information permits the planning of a specific AD for each defended asset, designed to counter the most likely air threat. Such threat analysis is critical to the proper and economical allocation of ADA resources.

Terrain. An analysis of terrain is also critical in this initial defense planning phase. All aspects of the geography of the battlefield must be considered: trafficability, relief, vegetation, and obstacles. Key terrain, terrain which is mission dependent and which would give either combatant an advantage if seized or held, must be identified. Dominant terrain surrounding the assets to be defended, which provides identification points for the enemy to fix the target, is considered key terrain. It is particularly critical for ADA commanders in the divisions to analyze terrain and identify low-altitude avenues of approach into the divisional rear areas. In situations where specific low-altitude avenues of approach are identified, the ADA commander may choose to allocate SHORAD weapons at selected points along these air corridors for the purpose of denying their use to threat aircraft. Such employment of SHORAD weapons reduces the number of ADA weapons that are allocated to point defenses of critical assets.

As such, this type of allocation should be limited to those specific operations over relatively limited periods of time where the benefits of such employment to the overall force operation exceed the risk to undefended critical assets. Additionally, terrain must be analyzed to identify both friendly and enemy observations and fields of fire. For example, high ground that affords protection as well as line-of-sight observation is critical to the positioning of ADA radar and OPs. Further consideration must be given to cover and concealment provided by terrain, the impact of weather on terrain, the impact of terrain on communications, and the degree of visibility afforded by terrain. Assets capable of dispersing and

blending into the terrain to take advantage of natural concealment may require less active AD protection, permitting a greater allocation of ADA resources to assets without effective passive AD means.

Troops. The final consideration of this initial phase of defense planning is an evaluation of troops available. For the ADA commander, this is a total assessment of his combat power; it involves consideration of such diverse factors as personnel strength, disposition of equipment, state of training, maintenance and supply readiness, adequacy of combat support and combat service support, troop morale, and the quality of his subordinate leaders.

Time. The final consideration in this phase of defense planning is an evaluation of time available for planning and executing the defense.

The commander considers the factors of METT-T, weighs them against the list of AD priorities, and develops an initial allocation of ADA resources to defend those priorities. Beginning with the highest priority asset, he decides how many of each type ADA resource to allocate to the AD of each asset. The force commander may approve these recommendations, reduce the list to increase the AD to selected assets, or expand the list to increase the number of assets afforded ADA coverage. Expansion will reduce the effectiveness of the overall defense. It is in this phase of the process that the ADA commander plays a critical role. As the AD staff officer, he must provide the supported commander with the advice which can make the difference between adequate and inadequate AD protection. Finally, those assets approved for active AD coverage by the supported force commander are listed in the ADA portion of the OPORD as AD priorities.

Defense Design Phase

After the decision concerning the number and type of ADA resources to be allocated to each priority is made, the ADA commander begins the second phase of the defense planning process, defense design. Defense design is the process of considering ADA employment principles, ADA employment guidelines, and ADA defense design requirements in conjunction with the weapon system capabilities to determine the location of specific ADA weapons in the defense of each AD priority. ADA commanders at all levels must design defenses to accomplish the AD mission for the specific tactical situation. Principles, guidelines, and requirements are provided to ADA commanders to assist them in increasing the effectiveness of ADs and enhancing ADA survivability. However, defenses are not designed simply to meet principles, guidelines, or requirements. Providing mass, mix, mobility, and integration in an AD is pointless if threat aircraft are permitted to release ordnance and destroy the defended asset prior to their own destruction. The focus for any defense must be the protection of the defended asset. Principles, guidelines, and requirements are applied to defense design with this in mind.

ADA Employment Principles

Four basic employment principles (Figure 40) provide the doctrinal basis for ADA defense design and underline the effective employment of AD weapons on the battlefield. The balanced application of these principles to fit the needs of the tactical situation can enhance the effectiveness of the AD and increase the survivability of ADA. These principles are discussed below.

FIGURE 40. EMPLOYMENT PRINCIPLES.

Mass. Mass is the concentration of ADA combat power achieved by allocating sufficient fire units to successfully defend the asset against attack. For SHORAD systems, mass is normally not achieved with units smaller than platoon size. However, in many instances, only a platoon of SHORAD weapons may be allocated to defend battalion-size maneuver unit and associated static assets. A unit smaller than a platoon should not normally be assigned an AD mission with the exception of MANPAD sections. In the case of HIMAD weapons, a battalion-size element is the smallest unit capable of achieving mass. Only in rare circumstances would an asset be defended with a HIMAD element smaller than a battalion (Figure 41).

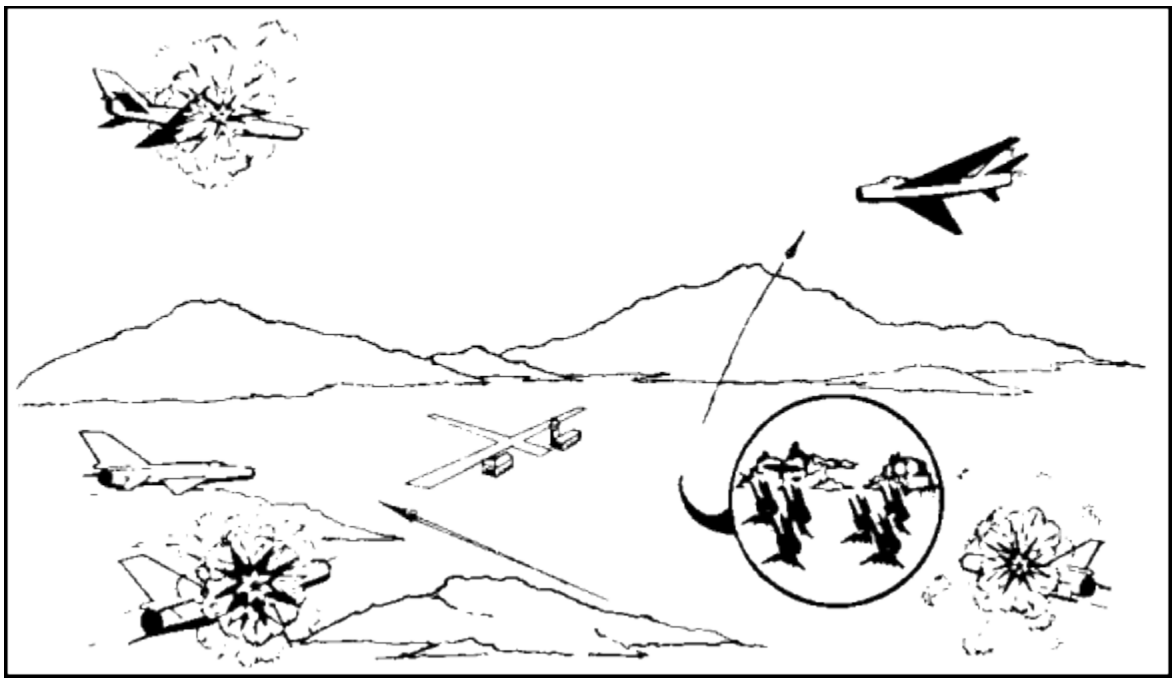

FIGURE 41. MASS COVERAGE.

Mix. Mix is a balance between AD aircraft and ADA systems, or between specific types of ADA systems, that offsets the limitations of one with the capabilities of the other. Mix forces the enemy to defend his air forces against an array of systems rather than against a single system. Defeating such an array of AD weapons, each with different characteristics and capabilities, is extremely difficult and greatly complicates threat strategy (Figure 42).

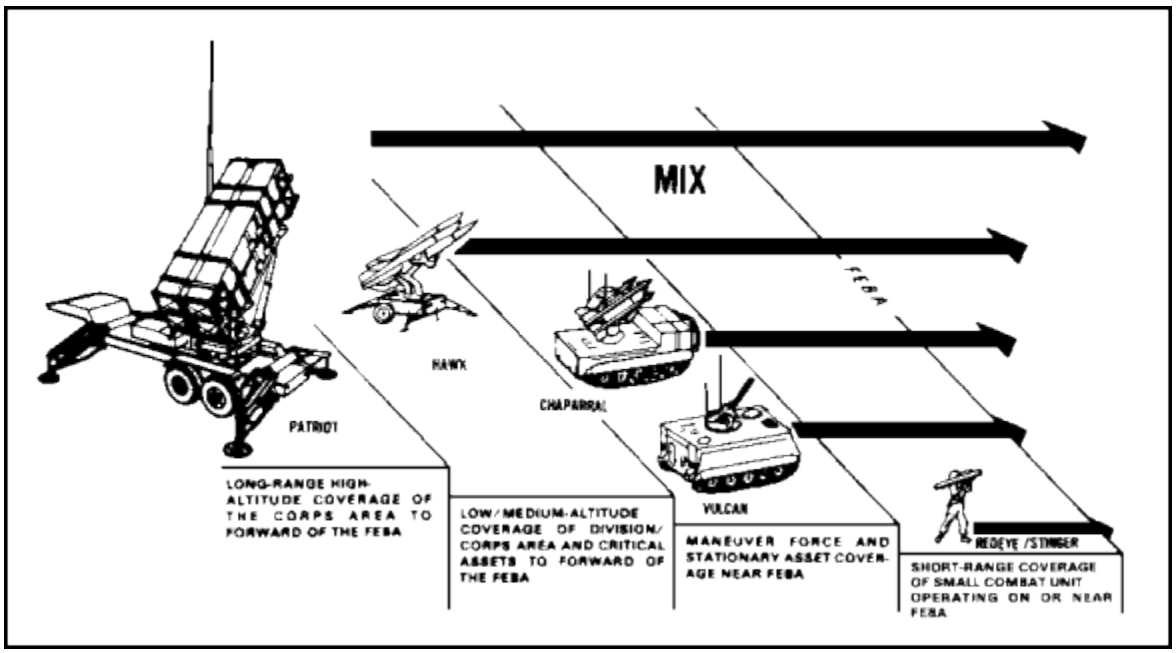

FIGURE 42. MIX COVERAGE.

Mobility. Mobility is the capability of AD forces which permits them to move from place to place while retaining the ability to fulfill their primary mission. ADA units tasked with providing AD to maneuver units should possess mobility equal to that of the supported element. ADA units defending static assets must be capable of rapid displacement to alternate and secondary positions as well. ADA units operating in a high-intensity environment must rely heavily upon mobility for survival as well as upon their AD capability (Figure 43).

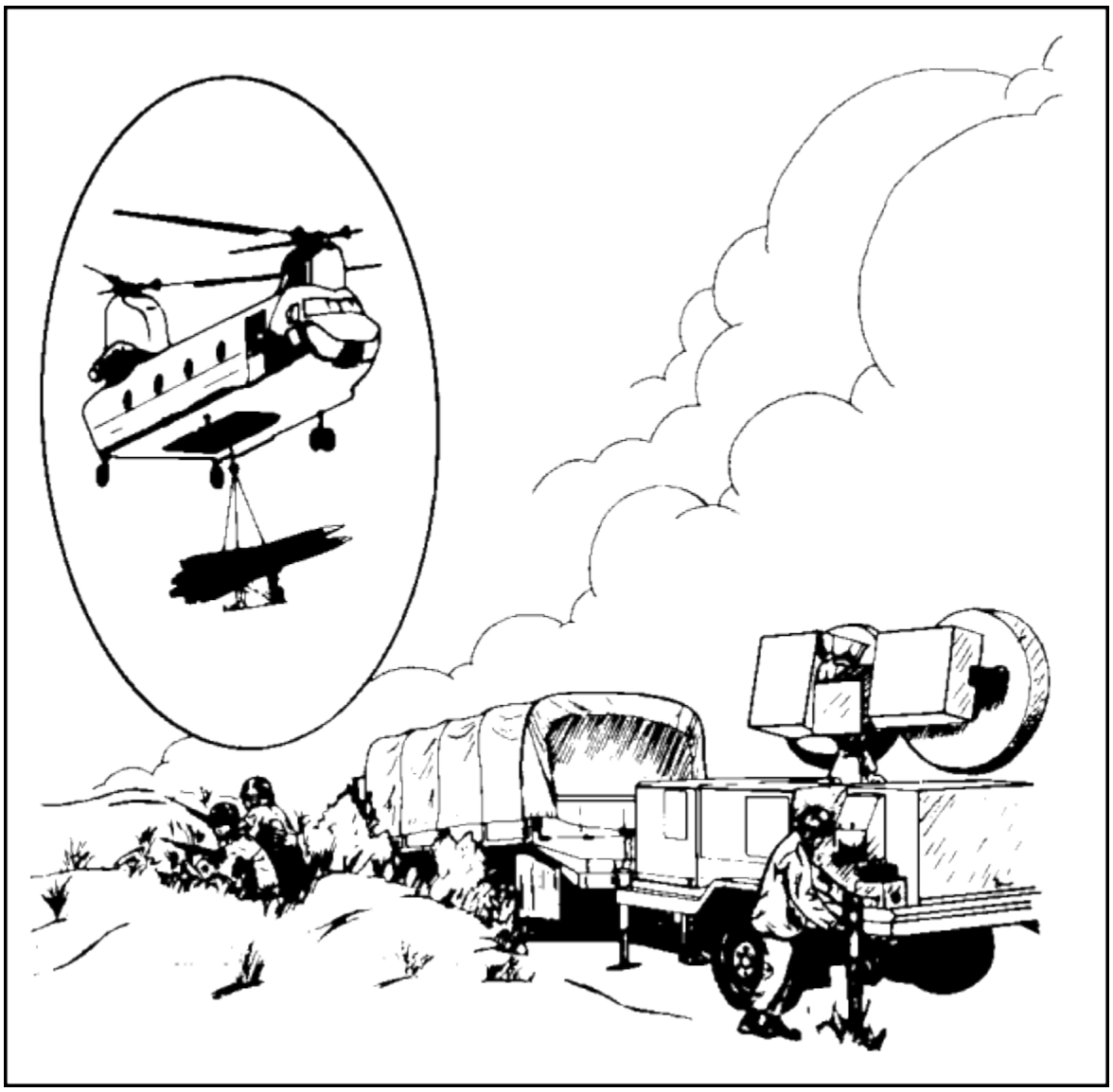

FIGURE 43. HAWK MISSILE MOBILITY.

Integration. Integration is the close coordination of effort and unity of action that maximizes individual AD system operational effectiveness while minimizing mutual interference among operating forces. Integration is vital to all operations on the AirLand battlefield. ADA weapons must be fully integrated into the force commander's scheme of maneuver and into the battle for air superiority as well. Massed, mixed, and mobile ADA weapons are integral parts of both the supported force commander's operation and the higher echelon ADA operation and must be responsive to both. Integration necessitates effective command and control links capable of sustained operations in a high-intensity NBC and EW environment (Figure 44).

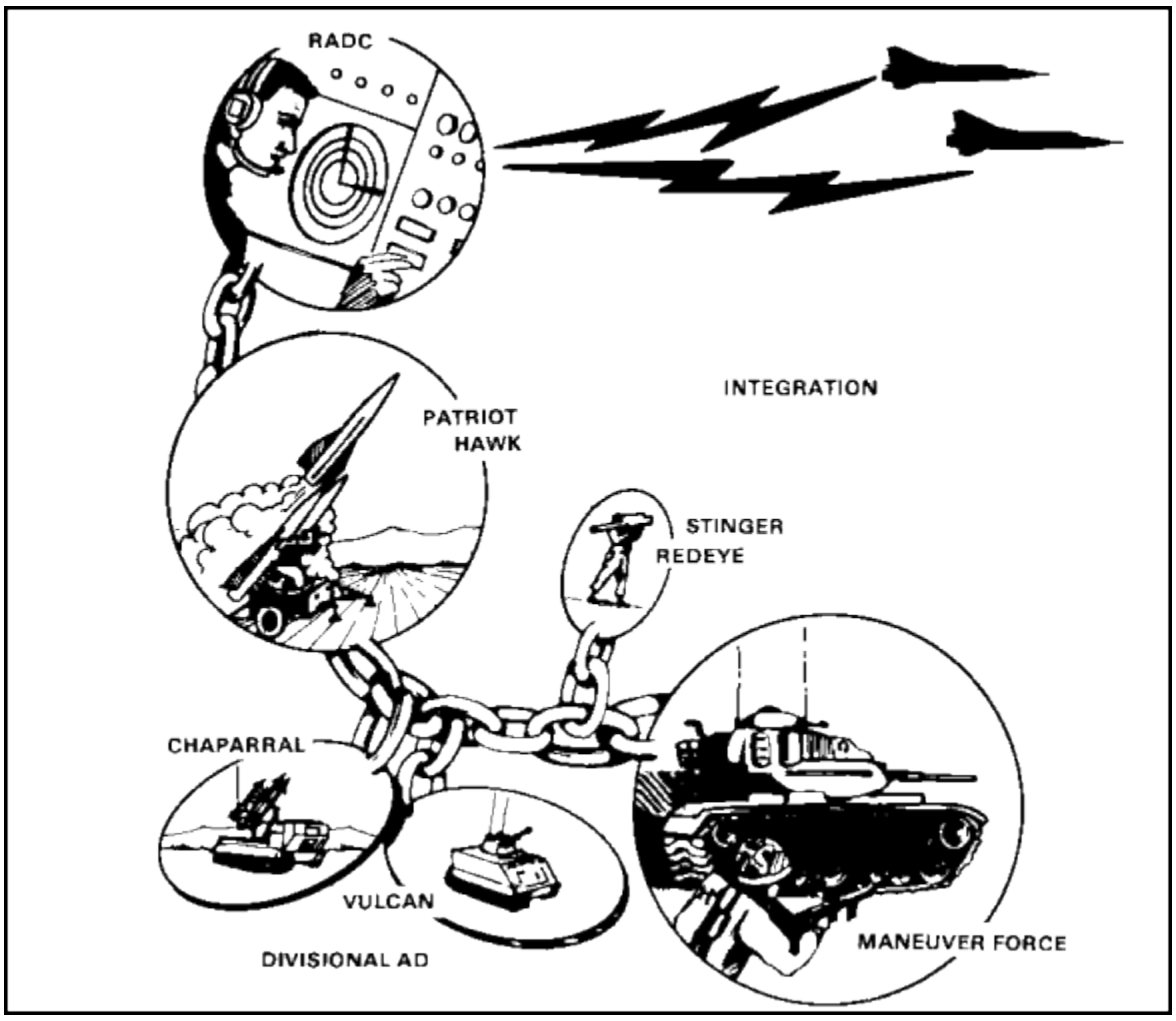

FIGURE 44. COMMAND INTEGRATION.

ADA Employment Guidelines

In conjunction with the ADA employment principles, the six employment guidelines in Figure 45 are the desirable characteristics of an "ideal" AD. They are provided as aids to ADA commanders for positioning individual fire units when tailoring an AD for a specific asset. In actual situations, the commander incorporates a mix of these employment guidelines in his defense according to the availability of assets and the tactical situation. Following all the guidelines, in actual tactical situations is seldom possible. The size and shape of the asset, the number of fire units available, the adequacy of terrain for coverage and emplacement, and numerous other tactical considerations limit the commander's ability to satisfy all requirements equally. Unfortunately, defenses have often been designed which focus more upon meeting guidelines than upon providing adequate AD coverage. Such is the case when a SHORAD defense of a critical asset is designed to optimize balance and mutual support. The net result is that fire units are emplaced too close to the asset to provide protection from realistic ordnance delivery methods.

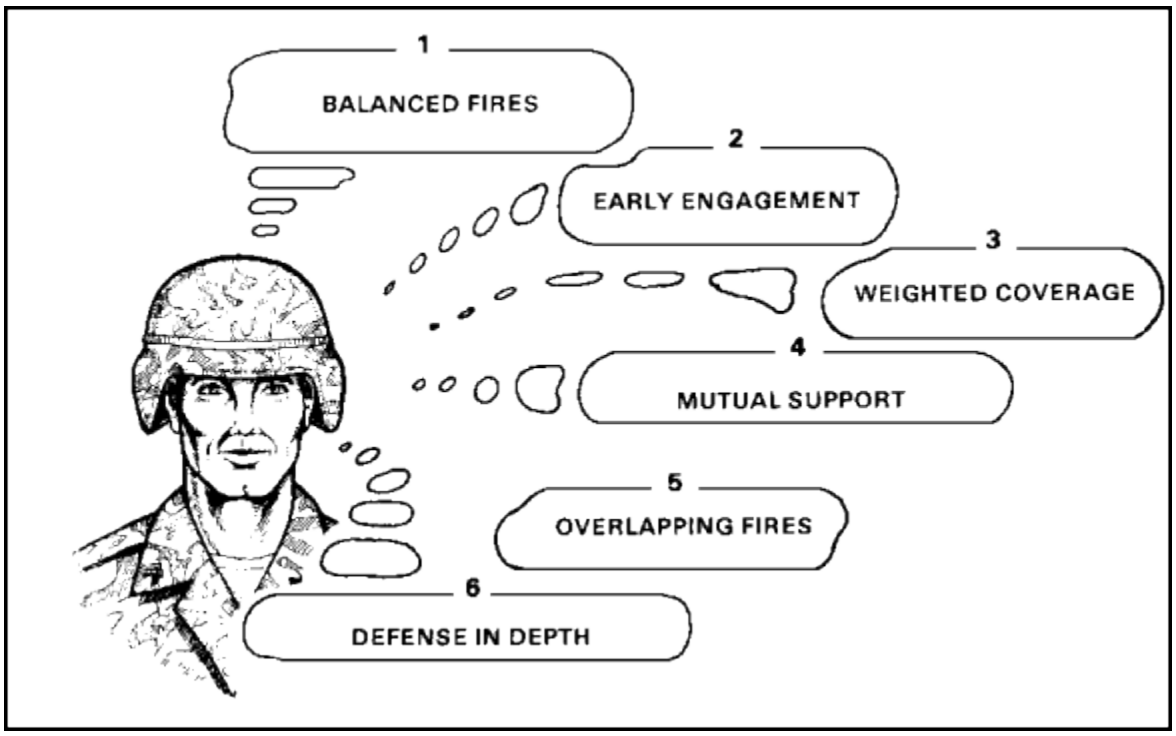

FIGURE 45. ADA EMPLOYMENT CONSIDERATIONS.

In the fluid, dynamic, high-intensity operations expected in future battles, rigidity, lack of originality, and lack of initiative can contribute to defeat. There is no substitute for the exercise of common sense, flexibility, and initiative to ensure that ADA units successfully accomplish their mission to support the ground operation. The six employment guidelines are discussed below.

Balanced Fires. This employment guideline is achieved by positioning ADA weapons to deliver approximately equal defensive fires in all directions (Figure 46).

Weighted Coverage. Weighted coverage is achieved by concentrating ADA weapon fires toward known enemy locations, unprotected unit boundaries, or enemy attack corridors or routes (Figure 47).

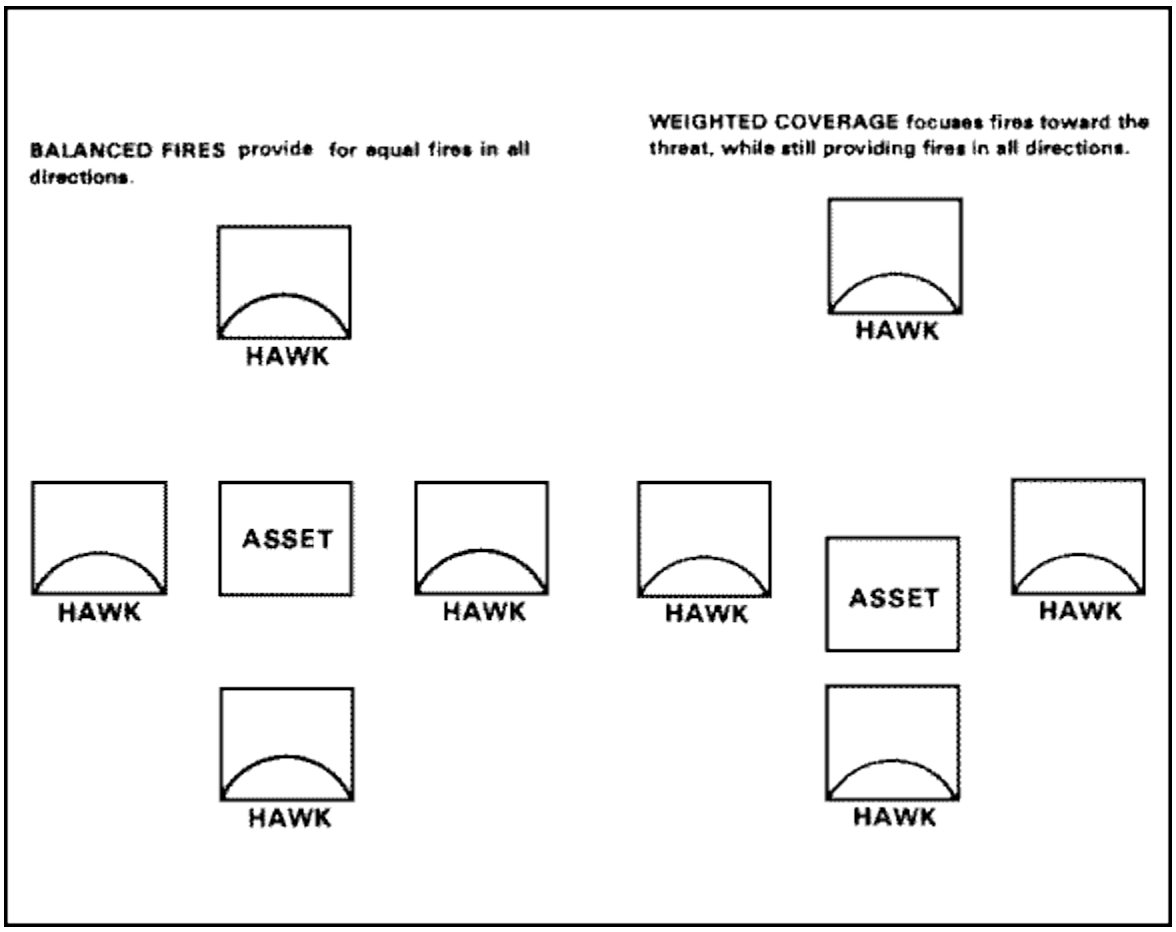

FIGURE 46 AND 47. BALANCED FIRES DIAGRAM AND WEIGHTED COVERAGE DIAGRAM.

Mutual Support. Mutual support is achieved by positioning individual fire units so that effective fires can be delivered into the dead zone surrounding an adjacent fire unit resulting from weapon system characteristics (exact separation distances are determined by consulting weapon system characteristics in (S)FM 44-1A(U)) (Figure 48).

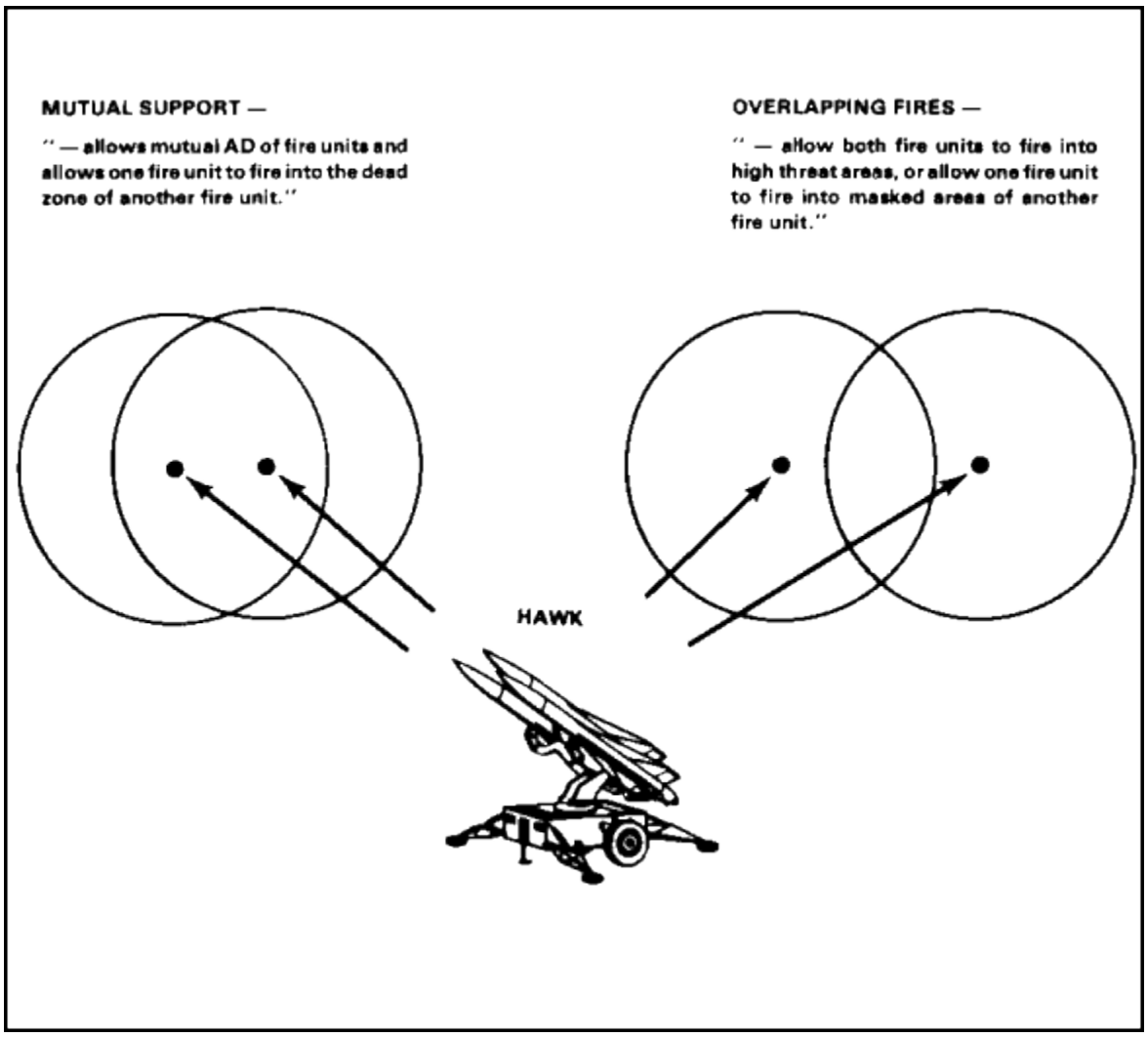

FIGURE 48. MUTUAL SUPPORT AND OVERLAPPING FIRES DIAGRAM.

Overlapping Fires. Overlapping fires are achieved by positioning ADA weapons so that engagement envelopes overlap. As the range of ADA weapons increases, terrain becomes a significant factor in determining specific overlapping fire distances (Figure 48).

Defense in Depth. This is achieved by positioning ADA weapons so that threat aircraft encounter an ever-increasing volume of fire as they approach a specific defended asset.

Early Engagement. Early engagement is achieved by positioning ADA weapons so that hostile aircraft are engaged prior to expected ordnance release (Figure 49). This guideline is effective against aircraft carrying conventional munitions only. Long-range standoff weapons such as ASMs or TBMs may be launched from anywhere on the battlefield.

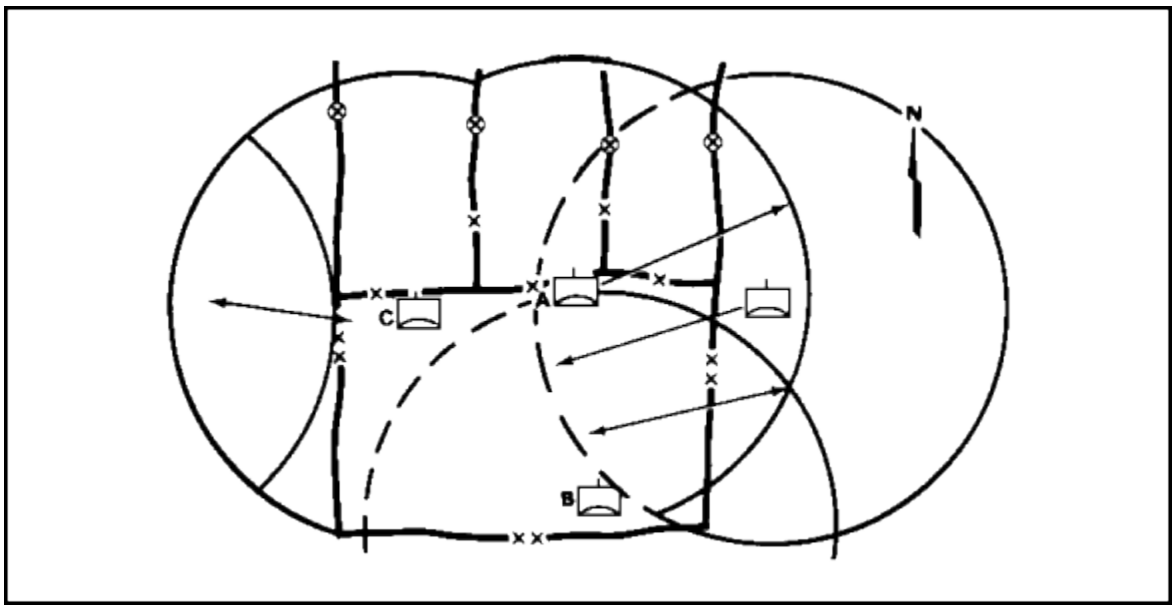

FIGURE 49. EARLY ENGAGEMENT DIAGRAM.

Evaluation of Alternatives Phase

Regardless of the tactical situation or the type of ADA weapon system involved in the defense, the commander who conducts the analysis and defense design phases will always have more than one alternative for providing ADA support. It is his responsibility to evaluate the alternatives to select the plan that provides the most effective, flexible AD possible to the supported commander. This does not imply that any single plan will provide the degree of support desired by the force commander, or that it can adequately protect each of the designated AD priorities. Each alternative plan, however, must be evaluated against the criteria of the AD mission--the degree with which a defense reduces or nullifies the effectiveness of attack or surveillance by hostile aircraft or missiles after they are airborne--and the best plan selected.

The evaluation of alternatives must consider the degree of AD provided by each defense against the expected threat. This is best accomplished by preparing a detailed firepower analysis for each alternative defense design based on the capabilities of each weapon system and comparing these design characteristics against the projected threat ordnance release line.

When the detailed defense design evaluation is not feasible due to time limitations or tactical constraints, the judgment and expertise of the commander and his staff are relied upon as the final determinants.

Implementation Phase

Following the evaluation of alternatives, the commander decides on the specific defense to provide for the AD priority or priorities. The ADA commander, regardless of level, is responsible for briefing the supported commander on the capabilities and limitations of the selected defense. If additional resources are required, the need is identified and appropriate requests forwarded to the next higher commander.

Following this coordination, the ADA commander prepares essential OPLANs and annexes to plans and disseminates this information to his subordinates. Each subordinate in turn follows the eight troop-leading steps to respond to the requirements of the commander issuing the OPORD. These steps (modified as necessary to fit the level of command and the tactical situation) are--

- Receive the mission.
- Issue the warning order.
- Make a tentative plan to accomplish the mission.
- Initiate the necessary movement sequence.
- Reconnoiter.
- Complete the plan.
- Issue orders.
- Supervise and refine.

This process is simply a more detailed and specific application of the procedure which resulted in the establishment of ADA priorities and established the initial allocation of ADA resources in their defense.

Learning Event 7:
SHORAD SYSTEM DEFENSE DESIGN

Fundamentals of SHORAD Defense Design

Each type of ADA system is designed to be most effective in defense of a particular volume of airspace over the battlefield. Therefore, an effective AD requires complementing the coverage and capabilities of more than one system to enhance the probability of destroying enemy aircraft. This forces the enemy to encounter an ever-increasing volume of fire from ever-increasing numbers of different ADA weapons, which complicates his ability to accomplish his mission.

Enemy defeat is best accomplished when each ADA weapon is employed so that its capabilities are maximized. The following text presents some basic characteristics for effective employment of each SHORAD weapon system.

Chaparral Employment

Chaparral is a self-propelled, short-range ADA guided missile system used to counter low-altitude threat. It is effective against high-performance aircraft, slower moving fixed-wing aircraft, and helicopters at ranges out to about 5 kilometers. Engagement ranges and effective ranges are dependent on such factors as the speed, size, aspect, visibility, and altitude of the target as well as weather and terrain.

While the employment of a single type of ADA weapon system in defense of an asset does not adhere to basic ADA employment principles, the scarcity of ADA resources may dictate such employment. Since Vulcan weapons are often committed to the support of maneuver units, a mission for which

Chaparral is not well suited because of its inability to shoot on the move, pure Chaparral defenses of stationary assets are common.

For point defenses, Chaparrals should be located--

- In firing positions which afford the greatest AD protection possible with available assets.
- Out from the asset to provide early engagement.
- Within mutual support distance or to provide overlapping coverage.

Reducing the number of Chaparral weapon systems employed in the defense of a particular asset necessarily reduces the number of, and extent to which, employment principles and guidelines are followed.

The Redeye and Stinger missiles assigned to Chaparral units are used to replace a Chaparral weapon that is temporarily out of action and or to supplement the defense to enhance mutual support and cover gaps that might otherwise exist in the defense.

Chaparral units are often required to provide AD for units while they are moving in convoy or march column along roads behind the line of contact. Since Chaparral cannot be fired while the carrier is moving, it is best employed by repositioning at critical points along march routes where convoys may be forced to halt or bottleneck. Key intersections, bridges, and other such points along heavily traveled routes in divisions, corps, and theater rear areas may be preplanned as targets by enemy air. When establishing a defense of a critical point along a march route, the design is accomplished as previously explained for stationary assets.

Vulcan Employment

The Vulcan is an ADA gun system used to counter the low-altitude air threat. Both the SP and towed versions are effective against high-performance aircraft, slower fixed-wing aircraft, and helicopters at ranges out to 1,200 meters. Specific weapon characteristics are available in (S)FM 44-1A(U). Although Vulcan is normally employed in an AD role, it is capable of providing ground fires against thin-skinned vehicles, personnel, and weapons to a range of about 2,200 (direct) and 4,500 meters (indirect). In its SP configuration, Vulcan is capable of firing while on the move, but fire delivered when the weapon is emplaced in a fixed firing position is more accurate. Mutual support and overlapping fire distances of Vulcan guns are 1,000 meters and 2,000 meters, respectively.

Static Critical Asset Defense. Towed Vulcans are normally employed in the defense of static critical assets. The Vulcan weapon is most effective when engaging targets in the head-on aspect (directly incoming). By positioning Vulcan weapons close to the defended asset, aircraft attacking the asset will appear as incoming rather than crossing, thus presenting a much better target for the Vulcan gunner. This, however, must be weighted against the need to position Vulcans far enough out from the defended asset to ensure engagement prior to ordnance release. Although it is not desirable to defend any asset with only one type of AD system, pure Vulcan defenses may be a tactical necessity. Employing Redeye or Stinger missile systems with Vulcan in a composite defense adds mix to the defense design and enhances the degree of SHORAD protection. Early engagement capability is increased and depth is added to the defense. In this type of mix, the Vulcan systems are deployed to balance the need to

provide mass, mutual support, or overlapping coverage. Redeye and Stinger are deployed farther out from the asset to enhance early engagement capability while attaining overlapping fire coverage of adjacent fire units.

Mobile Critical Asset Defense. Maneuver units in the forward area can expect attacks by both high-performance aircraft and helicopters. Although attacks from any direction are possible, attacks from the general direction of the enemy ground forces are most likely. Maneuvering units are more likely to be attacked as targets of opportunity than as preplanned targets. Therefore, jet aircraft attack techniques may be similar to those expected for the attack of march columns wherein the aircraft pilot first finds and fixes his targets, then attacks.

When AD priority is accorded to maneuver elements, in many cases only Vulcans and MANPAD systems are used to support them. Vulcan's mobility, ability to fire on the move, minimum preparation time, and head-on capability give it some capability to protect a moving, exposed maneuver force. Towed Vulcan is not well suited for defense of moving maneuver forces because of its lack of armor protection and inability to shoot on the move.

When a significant air threat exists, an SP Vulcan platoon normally supports a battalion-size task force. Because there are not enough Vulcans available to cover the entire force, priority for Vulcan support is typically to the maneuver units that are critical to the success of the operation (for example, the units spearheading the attack). As with all ADA weapons, however, Vulcan is allocated to the defense of the supported commander's priorities.

Employment of Vulcan in platoon strength increases massed fires, facilitates positive command and control, and minimizes logistical problems. If employed in less than platoon strength, at least two fire units should be employed together. These should be placed under the direct control of the platoon leader or platoon sergeant, not the supported unit.

Vulcans supporting the maneuver force move with the company teams. They are normally positioned so that two-thirds of the Vulcan's effective AD range extends forward of the defended force and or they are positioned within the maneuver formations to defend against air attack along the axis of the formation.

When the supported force is moving by bounds, Vulcan normally remains with the overwatching element. Characteristics of overwatch positions selected for maneuver elements generally coincide with the position requirements for Vulcan including--

- Good observation and fields of fire.
- Protection afforded by covered and concealed positions.
- Immediate and controlled reaction to any air threat (Vulcan in position and ready to fire from a stationary platform).
- Relative high terrain, enhancing line-of-sight communications.

However, Vulcan may move with the bounding element if a high probability of air attack against the bounding element exists or if the bounding element cannot be adequately covered throughout the

bounding because of Vulcan's range limitations (that is, the distance between overwatch positions is greater than 1,000 meters).

When positioning Vulcan with the overwatch or bounding element, the commander should consider the vulnerability of the SP Vulcan vehicle in relation to the tank vehicle. Nevertheless, the mission will be the overriding determinant.

When Vulcan units are supporting maneuver battalions and companies, the Vulcan unit commander will adopt the movement and cover tactics of the supported force. The supported commander's maneuver decisions are followed even if they conflict with Vulcan occupation of good AD firing positions.

When a Vulcan platoon or section is supporting a company which is also supported by one or more Redeye or Stinger teams, the Vulcan platoon or section leader should have the authority and responsibility for controlling and positioning the Redeye and Stinger teams.

Although AD is its primary mission, Vulcan is also used in a ground support role and has an excellent capability to suppress enemy antitank and other crew-served weapons. The decision to employ Vulcan in the ground role must consider the greater immediate threat to the maneuver force and the availability of ammunition.

Vulcan is more effective in convoy defense when integrated into the march column. The number of Vulcans required to adequately protect a convoy is dependent upon the length of the convoy. Integration into the convoy is accomplished by placing a Vulcan among the first four or five vehicles (500 meters) both at the front and rear of the convoy, filling in the remaining Vulcans at 1,000-meter intervals working toward the convoy center from each end. This employment weights the defense toward the ends of the convoy and provides mutual support between weapons. Vulcan is deployed in not less than platoon strength in convoy defenses. Additional Vulcans are added in sections of two.

C/V Composite Employment

C/V batteries are normally employed to defend prioritized assets of the division or corps commander. Although divisional C/V battalions are organized with pure Chaparral and Vulcan batteries, platoons are usually cross-attached to form composite batteries to support tactical operations. Composite batteries provide a mix of weapons including organic Stinger. When organized as a composite battery--

- Position Vulcans far enough from the defended asset to permit engagement of threat aircraft prior to ordnance release. Positioning Vulcan systems directly on the defended asset might permit asset destruction prior to target engagement by the Vulcan fire unit.
- Position Chaparral fire units farther from the defended asset (4 to 6 kilometers) within mutual support distance of one another when possible. This employment permits early engagement beyond the threat ordnance release point. The head-on engagement capability of the improved Chaparral missile increases the capability of the system to destroy the threat prior to ordnance release. If a likely avenue of enemy approach is known, then position some of the fire units so that the likely approach receives weighted coverage. If not, position fire units to provide a

balanced defense. All around coverage is a desirable defense characteristic, but is not always feasible because of weapons allocation and positioning constraints.

- Position Chaparral fire units and Vulcan gun systems optimally to obtain mutual support. Specific mutual support distances are determined by consulting engagement envelopes in (S)FM 44-1A(U). These distances are generally not allowable because of the limited ADA resources. Fire units provide overlapping coverage if the tactical situation prevents mutual support.
- Use organic Stinger and Redeye to compensate for gaps and to augment the coverage provided by Chaparral and Vulcan systems.

M42 Duster Employment

Many of the Vulcan employment techniques are applicable to M42 Duster units. Dusters are best employed in battery strength, but are also employed in platoon strength. In certain instances, four squads are used for point defense. Factors which affect the Duster's tactical positioning are generally the same as for Vulcan to include mutual support distances. In a ground role, Duster has indirect fire capabilities. More information on Duster is available in FM 44-2.

Redeye Employment

Redeye is a heat-seeking weapon with an effective range in excess of 3,000 meters. This system is usually employed to support tactical operations and to provide point AD for critical assets or other ADA systems. In all operations, Redeye is positioned to provide early engagement of low-altitude, hostile aircraft and, if possible, overlapping Redeye fires. Because of their limited head-on capability, Redeye fire units are positioned well forward of the defended asset, consistent with security requirements.

The supporting Redeye section leader frequently serves as the AD officer for a supported unit. As such, he is responsible for advising the commander on all AD matters to include the employment of small arms in the AD role. In all defenses, the Redeye section leader commands his fire unit, positions his teams, and supervises the distribution of his assets. Additionally, he provides command and time-sensitive AD warning information from the C/V battalion CP and the FAAR to his teams. The actual minute-to-minute control of engagement is directed by the Redeye team chief in accordance with applicable ADA rules of engagement.

The employment of Redeye teams is determined by ADA employment guidelines, principles, system requirements, and the specific tactical situation. Positioning of teams by the section leader should optimize the AD protection afforded by the available fire units. Allocation of Redeye assets is determined by the AD priorities established in the OPORD. Redeye protection is integrated into the overall SHORAD defense and augments the protection of the other ADA weapons in both offensive and defensive operations.

Stinger Employment

Stinger is a man-portable, shoulder-fired, IR homing guided missile system. It requires no control from the gunner after firing and has an IFF capability. Stinger's primary role is to provide AD for forward

combat elements against low-altitude hostile aircraft. It also defends other high-priority maneuver units and assets such as command and control facilities, ASPs, and POL points when designated as priorities by the supported commander. Stinger gives the ADA commander an extremely important capability to provide a missile mix to ADA gun defenses.

Stinger assets of a division are consolidated at, and organic to, the SHORAD battalion. Additionally, Stinger assets are organic to corps artillery; armored cavalry regiments; separated armored, infantry, mechanized infantry, and air cavalry brigades; and HIMAD units for close-in protection.

Because of its flexibility, extended range, and mobility, Stinger is frequently the best weapon for defending exposed, moving maneuver forces. However, both Stinger and Redeye are limited by organic transportation in cross-country movement. The only viable type of AD for Stinger employment is the point defense (to include static point and mobile point defenses). When tactically possible, a mix of ADA gun systems is provided for Stinger defenses to enhance the degree of protection afforded the asset.

Stinger in Static Critical Asset Defense. Stinger's ability to engage approaching aircraft makes it valuable for stationary point defenses. Its effectiveness is significantly enhanced when ADA gun systems are allocated to the same defense. The first step in planning a stationary point defense is defining the borders of the defended asset and establishing realistic ordnance release lines for the expected threat. Vital points within the defended area are identified, and probable or forced routes of approach into the defended area are considered. Teams are normally positioned so that the engagement capability of one team overlaps that of an adjacent team. By following this guideline, the section chief can guard against the possibility that threat aircraft will slip through the defense without being engaged by at least one Stinger team. Positioning teams between 2 and 3 kilometers apart will normally provide this capability. In cases where more than one weapon system is employed in the same defense, overlapping fires are achieved between weapon systems. When permitted by the tactical situation, teams are positioned far enough out from the defended asset to permit threat aircraft engagement prior to ordnance release.

Selected firing positions should offer cover and concealment for team protection from enemy observation and fire. Because the dust and smoke signature produced by a missile firing can expose the firing position to identification and attack by enemy aircraft, the team immediately takes cover after firing. Relocation takes place only if the team feels the position is actually pinpointed for pending attack. The technical characteristics of the Stinger system require the establishment of a safety zone free of personnel to a distance of 50 meters behind the weapon and equipment within 5 meters of the weapon.

Stinger in Mobile Critical Asset Defense. Stinger provides the ADA commander with an excellent capability to protect mobile point defenses to include maneuver units on the move. In protecting a maneuver force, the proximity of the Stingers to the FEBA increases the importance of physical security, mobility, and position requirements. To perform their mission effectively, Stinger teams must be secure from ground attack. In most cases, this substantially reduces the capability to provide early engagement by the Stinger teams. Additionally, Stinger teams allocated to such defenses must keep up with the supporting units to prevent separation from the force and exposure to enemy attack.

Because of the reduced capability to provide early engagement, the Stinger teams defending moving forces must select positions as close behind the force as is tactically feasible. Selected positions should provide all-around observation and line of sight with a FAAR when tactically possible. This typically dictates the selection of positions on high terrain. When such positioning is not possible, the teams should position themselves to observe the most probable avenue of approach as a minimum.

Adequate Stinger AD protection during actual maneuver phases is contingent upon the careful defense planning of the Stinger section leader and team chiefs. Enemy air attack characteristics against such maneuver units are very similar to the attack of march columns. High-performance aircraft pilots will typically attack these elements as targets of opportunity requiring pilots to first find, then fix and attack the force. Taking such factors into consideration when planning Stinger defense of maneuver units is essential to increasing its effectiveness.

Stinger in Defense of Convoys. Stinger teams often provide AD for units moving in convoy or march column along roads behind the line of contact. Such convoys are typically attacked as targets of opportunity forcing enemy pilots to find, fix, then attack the convoy. Stinger defense of such convoys is conducted by either pre-positioning teams along the route of march or integrating teams into the march column. The type of defense selected by the ADA commander is contingent upon the available ADA resources, the factors of METT-T, the number and location of critical points along the route, the length of the convoy route, and the availability of other ADA resources.

Pre-positioning Stinger teams at critical points along the route of march is used only if the route is relatively secure from ground attack and time permits the teams to occupy positions ahead of the column. Pre-positioning is considered if these requirements are met and if specific critical points such as bridges, road junctions, or refueling points are identified as likely points for attack. Should this method be selected for convoy defense, careful planning is essential from these critical points, and some procedure must be established for reintegration of the Stinger teams into the supported force. Employing Stinger teams in leapfrog style to defend a series of points along the route of march is attempted only if there is an additional secure route along the main convoy route to permit rapid sequential employment without interfering with the convoy.

If Stinger teams are integrated into the march column to provide AD (Figure 50), the specific positioning is contingent upon the length of the convoy and the number of available Stinger teams. It is extremely important to position teams near the front and rear of the convoy and distribute additional teams equidistant throughout the rest of the column. When tactically feasible, these teams are located less then 3,000 meters apart to provide overlapping fires. This reduces the chance of an attacking aircraft completing the mission without entering the engagement envelope of a Stinger team.

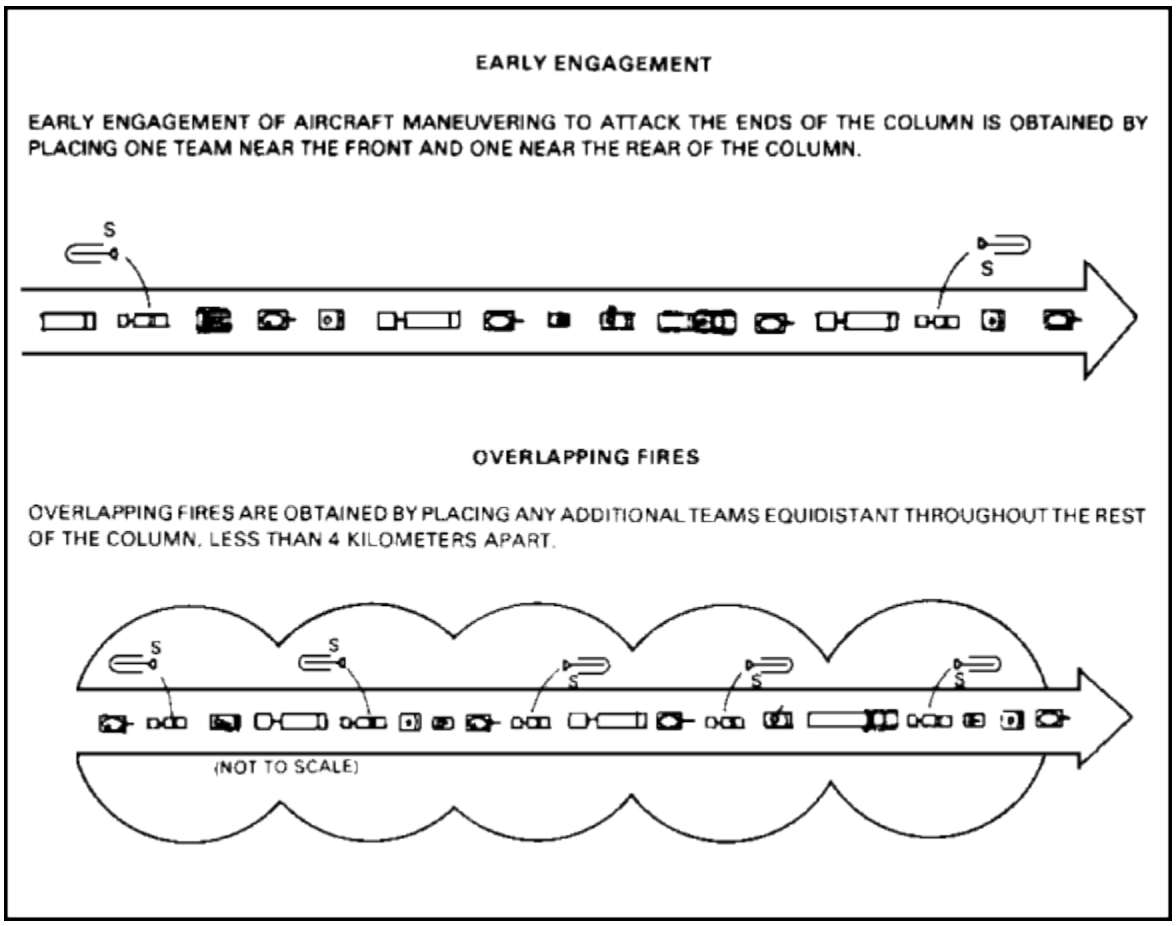

FIGURE 50. STINGER INTEGRATED WITHIN THE MARCH COLUMN.

Lesson Event 8:
HIMAD SYSTEM DEFENSE DESIGN

Hawk Employment Guidelines

Hawk commanders consider standard ADA employment guidelines when positioning fire units to provide defenses within the corps and rear area. However, as with other ADA systems, strict adherence to employment guidelines is impossible in most situations. Practical considerations, such as the size and shape of the defended asset or area and the number of weapons available, limit a commander's ability to meet the guidelines. Therefore, the employment guidelines are listed in a descending order of priority. The commander is the final authority on deciding which guidelines can be achieved. In most cases, the result is a compromise. It is essential to integrate HIMAD and SHORAD coverage to the greatest extent possible.

Area Defense

Weighted Coverage. Hawk coverage is weighted toward the FEBA and any exposed (having little or no AD coverage from an adjacent AD unit) unit boundaries.

Early Engagement. Hawk positioning should ensure coverage of low-altitude routes of approach to permit engagement of aircraft as far forward of the defended area as possible. Although it is desirable to cover all low-altitude approaches, in many instances there may not be enough weapons available to accomplish this. Therefore, certain routes (for example, valleys, rivers) that allow aircraft low-level approaches to defended assets should receive weighted coverage.

Defense in Depth. Defense in depth subjects an air threat to an ever-increasing volume of fire from the moment it is detected and identified as hostile until it is destroyed or has broken off the attack. Since the Hawk commander will usually employ his weapons throughout the defended organization's area of operation, both laterally and in depth, he will achieve some degree of defense in depth. Total defense in depth is achieved through the integration and coordination of all ADA weapons used in defense of an organization.

Mutual Support and Overlapping Fires. When defending an organization, Hawk positioning should provide for mutual support whenever possible. If weapon resources, size of the organization, or density of the defended critical assets prevent mutual support, then, as a minimum, weapon positioning should provide for overlapping fires to prevent gaps in the defenses.

Mutual support is obtained by placing adjacent Hawk firing platoons no farther apart than 20 kilometers. Overlapping fire is achieved by placing Hawk firing platoons no farther apart than 40 kilometers.

Point Defense

Hawk is usually employed in point defenses to defend critical assets within the corps rear area (COSCOM, corps, reserve) and the rear area (logistic complexes, port facilities). The employment guidelines in these instances are somewhat different than when Hawk is employed in an area defense.

Balanced Fires. Position firing elements to deliver balanced fires in all directions.

Early Engagement. Position weapons to provide for early engagement of threat aircraft before their ordnance release, particularly along low-altitude avenues of approach.

Mutual Support and Overlapping Fires. Same as for area defense.

Support for a Division

If assigned an R or GS-R mission of a divisional ADA battalion, Hawk will augment the coverage of the divisional battalion by providing low- to medium-altitude defense to forward maneuver elements or other unprotected prioritized battlefield assets.

Hawk provides the division with capabilities not achievable by the organic division SHORAD battalion. Hawk further complements the defense by increasing the weapon mix and compounding the enemy's countermeasure problem. The extended altitude capability of Hawk may force the attacker low, thereby increasing the effectiveness of divisional systems.

The Hawk commander receives his priorities for AD from the supported commander through the reinforced ADA commander. Through coordination with the division G3, battery positions are selected that best support the division's scheme of maneuver or defensive plan. The Hawk commander

positions his firing elements as far forward within the division area as is feasible, considering the effects of enemy mortar and field artillery fires, to provide AD coverage as far forward of the maneuver elements as possible. As a general rule, Hawk firing elements are not positioned within range of the enemy's medium field artillery (for example, 122-millimeter gun/howitzer). If the mission dictates, the Hawk battalion may have to accept the risk and move selected units forward to provide AD support to the maneuver force.

Hawk battery or platoon displacement distances and the selection of successive firing positions are influenced by the division's scheme of maneuver and progress of the AirLand battle. As the division maneuvers, the Hawk commander moves his units by echelon to provide continuous coverage for the lead maneuver elements as they advance.

The reinforcing Hawk battalion is integrated into the division's ADA plan through Hawk and SHORAD commander-to-commander coordination. The Hawk commander's mission does not change the role or responsibilities of the SHORAD battalion commander. The SHORAD commander is the division ADA officer and principal advisor to the division commander on AD matters. The SHORAD battalion's TOC is the divisional AD TOC when a Hawk battalion is supporting the division. The difference in Hawk and SHORAD weapons range and altitude capabilities, mobility, method of employment, and the need to complement each system's capabilities, allow the two commanders to provide the best possible AD protection for the ground commander. The SHORAD commander is knowledgeable of Hawk capabilities. Frequently, he is requested to advise the division commander concerning use of Hawk to best support the division's scheme of maneuver.

The reinforcing mission requires a Hawk battalion to have liaison and communications with the supported unit. This is effected by sending an AD coordination team from the supported SHORAD battalion to the Hawk battalion fire distribution center. This coordination team uses the Hawk TOC communications tie-in with Air Force command and control facilities to receive time-sensitive AD and early warning information. This information, in turn, is sent to the SHORAD battalion TOC and the DAME. The Hawk battalion also sends a liaison officer to the SHORAD TOC.

Patriot--New Approach to Defense Design

The Patriot missile system provides very low- to very high-altitude AD of ground combat forces and critical assets. Patriot battalions are typically assigned to ADA brigades to provide defense of critical theater assets.

The unique characteristics of the Patriot system demand new approaches when designing defenses. Normally, the Patriot battalion is employed in one of two types of defense. These types are the point defense of critical assets such as air bases, logistical complexes, ports, etceteras, and the area defense in support of deployed forces or critical assets, to reduce the enemy air threat.

Deployment Considerations. Patriot is normally employed in battalion-size units consisting of six batteries (six fire units) and a battalion ICC. The minimum deployable unit is dictated by the following factors:

- Overlapping fires of at least one other fire unit are required.

- Sector coverage of a Patriot defense consisting of fewer than three fire units may place severe coverage constraints on the defense.
- The battalion ICC is necessary to ensure effective fire distribution and defense integrity.

Siting Considerations. The Patriot battalion is employed as an integral unit and sites are selected accordingly. Several key planning considerations which govern Patriot site selection are as follows:

- Selected sites must contribute to an effective battalion defense. Proposed sites which may be ideal for fire unit operations, but provide little contribution to the overall defense, are not effective site locations.
- Sites must provide mutual support or overlapping fire between units. If possible, each fire unit's position is covered by at least one other unit. As a minimum, fire unit positioning should prevent gaps in the defense and facilitate triangulation within the battalion.
- Sites are selected so that degradation of the defense through attrition of individual fire units is minimized by retraining adjacent fire unit coverage sectors to fill gaps.
- Sites should afford natural cover and concealment for support elements.
- Sites must meet the requirements for placement of system equipment (slope, cable length, etceteras).
- Accessibility of proposed sites to Patriot equipment is one of the most basic considerations. Physical characteristics of the equipment will necessitate selection of fire unit locations which are readily accessible from improved road networks. Additionally, survey and leveling requirements may preclude Patriot use of available terrain.
- Battalion communications relay sets are sited to support optimal defense design. Their siting requirements are considered early with proposed battalion sites.

Launcher Deployment Considerations. Launchers are deployed to provide maximum firepower forward while still retaining the capability to engage in secondary sectors of fire.

Launchers are oriented to reduce system dead zone. The launchers to be fired from first are sited to facilitate reloading.

Area Defense

Patriot battalions in area defense are deployed to cover a broad area with no particular asset within the area given priority of coverage. Patriot units can provide area coverage against a low- to high-altitude threat. The AD commander assigning the area defense specifies the area to be defended. Patriot may also be deployed in a belt type area defense.

Point Defense

Patriot units also provide defense for critical assets such as major air bases and logistic complexes. The proper deployment of a Patriot battalion for the effective defense of a given asset is dependent on--

- Terrain.

- Size of the asset.
- Location of the asset.
- Nature of the asset.
- Air threat.
- Vulnerability of the asset.

In a balanced defense--

- All-around defense is provided.
- Target lines are selected so that the defended assets lie within the radar surveillance fan of each of the defending fire units.
- Opposite fire units are located within optimal engagement range of each other.
- Because of terrain limitations and other constraints, all employment considerations are seldom met.

A critical asset weighted defense--

- Provides weighted coverage along the primary avenue of approach.
- Provides coverage against the 360^{o} threat.
- Provides mutual support.

Alternate and Secondary Positions

Alternate positions are selected for fire units for occupation and continuance of the mission when primary positions are threatened by AD suppression. Alternate positions need not, and should not, be far from primary positions--a distance of several kilometers is normally sufficient to negate suppression attempts. With alternate positions close by, system downtime due to movement is minimized and defense integrity is maintained when these positions are occupied. So that the overall defense is not prejudiced by their use, alternate positions should meet the same requirements as the primary positions. Secondary positions are selected to accommodate changes in the tactical situation to include leapfrogging the defenses to follow major redispositions of ground forces. Positions are selected and successively occupied to ensure the continuance of integrity of the defense. Defenses are continually planned, analyzed, and adjusted using basically the same considerations as used in designing the initial defense.

Learning Event 9:
COMMAND AND CONTROL

The ability of ADA units to function effectively on the battlefield depends on effective command and control. As with every component of combat power, AD fires are directed and controlled to contribute to the overall objective of the force. This portion of the lesson provides commanders and their staffs

with information to integrate AD fires into both the force commander's scheme of maneuver and the battle for air superiority.

Fundamentals

Command and control is the process of directing the activities of military forces to obtain an objective. This process involves two basic concepts. First, command is the authority and responsibility to use available resources to accomplish missions in accordance with established procedures. Second, control is the authority, which may be less than full command, exercised by a commander over part of the activities of subordinate or other organizations.

Command and control functions are performed through the integration of personnel, communications, facilities, equipment, and procedures which allow the commander to plan, direct, and coordinate his forces in the accomplishment of the mission.

Operations on the battlefield of the future will place extreme stress on command and control links at all levels. The tactical situation will probably be obscured; time available for making decisions will be compressed; massive personnel and materiel losses will result in psychological stress; and conventional operations will integrate with nonconventional operations. Each of these factors must serve as design considerations for establishing effective command and control facilities and procedures.

The heart of command and control is the cycle of acquiring information, evaluating its content, making appropriate decisions, issuing instructions, and monitoring subordinates for compliance. The element which underlines all these tasks is time. The command and control cycle must be well organized and efficient so that it is completed more quickly than the enemy command and control cycle. Speed is vital to effectiveness, and effectiveness in command and control is a prerequisite to successful AD.

Cornerstones

Three fundamental tasks form the basis for AD command and control. These cornerstones relate the management of AD systems to the conduct of the overall air battle. They are--

- Centralized management with maximum decentralized authority to engage.
- Air battle management.
- Management by exception.

Centralized Management With Maximum Decentralized Authority to Engage

Organizations established for AD operations are an integral part of the overall force structure. Of necessity, AD organizations comprise different command levels and areas of responsibility. Centralized management must therefore be exercised to ensure the coordination, integration, and maximum operational effectiveness and economy of the entire AD organization. However, the basically reactive nature of AD prevents a single commander from directing the myriad actions required in defending a large number of assets. To ensure rapid and flexible response to the threat, decentralized execution of AD tasks is essential. This is accomplished by delegating authority for mission execution.

Air Battle Management

Air battle management encompasses the principles for the control and coordination of both tactical air and ground-based AD resources. This includes airspace management as well as AD command and control. Close coordination among the diverse elements of an AD is important because of the short reaction times required to engage threat aircraft, and the need to integrate AD operations with all other air and ground operations. This coordination becomes even more critical in the integration of AD operations with the offensive air operations. Exacting centralized coordination must be effected to prevent mutual interference between ADA weapons and offensive air forces. There are two basic established methods for exercising air battle management: positive management and procedural management.

Positive Management. Positive management relies upon real-time data from radar, IFF, computer, digital data link, and communications equipment to provide AD command and control and airspace management. Positive management facilities are vulnerable to attack, sabotage, and electronic interference. Line-of-sight requirements and limited communications can also restrict the data from these facilities.

Procedural Management. Procedural management relies upon the use of techniques such as segmenting airspace by volume and time and the use of WCSs to manage the air battle. Procedural management techniques are usually more restrictive than positive management, but are less vulnerable to degradation from electronic or physical attack. They significantly enhance the continuity of operations under the adverse conditions expected on the modern battlefield. When positive management is employed in the air battle, procedural management must be available to provide an immediate backup system should degradation occur. Additionally, procedural management provides a permanent management means for AD systems that do not have real-time data transmission capability.

In most cases, a combination of positive and procedural management will be used to manage the air battle. The specific mix is determined by considering--

- The nature and magnitude of the enemy operations and threat.
- The availability, capability, reliability, and vulnerability of the air battle management facilities. This includes consideration of airborne and surface AD facilities as well as peacetime air traffic control and terminal control facilities.
- The number, deployment, and characteristics of friendly airborne weapon systems.
- The type of terrain and weather conditions (current and projected) in a combat area.
- The capability of identifying aircraft by electronic means. The methods used for managing the air battle will probably differ for each of the two sectors of the combat area--the rear area and the MBA. The division of these areas is based upon the general patterns of air traffic flow and the types of combat activities which take place in each. Normally, the boundary between the MBA and the rear area will be the brigade rear boundary.

In the rear area, air traffic will usually travel along an axis perpendicular to the FEBA between forward and rear areas. Movement in this area is more definitive; therefore, it is better suited for electronic

control. As such, aircraft are controlled by radar to the maximum extent possible, and ADA units within the area manage primarily through positive management means. As stated previously, procedural techniques will provide backup management capability.

In the MBA, air traffic will generally travel on routes perpendicular and parallel to the FEBA. Aircraft in this area will provide rapid, flexible response to the requirements of both the air and ground commanders. This mandates freedom of movement for friendly aircraft operating throughout the area which makes individual control of air traffic extremely difficult. ADA units operating in the MBA will, therefore, be primarily managed through procedural management techniques.

Management by Exception

This cornerstone of AD command and control reinforces the theme that no single commander can direct the overall air battle on a real-time basis. The AADC and or RADC must supplement positive management with procedural techniques to ensure coordination and provide unified direction to the battle when positive management capability is degraded. However, due to the unpredictable nature of combat, tactical situations may arise which were not addressed in procedural or positive rules and directives. In such instances, positive management exceptions are made on a case-by-case basis to countermand or modify previous guidance (either positive or procedural). Strict procedural management is used only when a mix of positive and procedural techniques is not achievable (for example, during a communications outage, or for units without real-time data transmission capability).

Command and Control Structures

ADA is unique in that it relies upon separate chains for command functions and control functions.

The Command Chain

The command chain (Figure 51) links the theater commander, the Army component commander, the Army AD command commander, the ADA brigade commander, the ADA battalion commander, the ADA battery commander, and the ADA platoon leader in a successive chain.

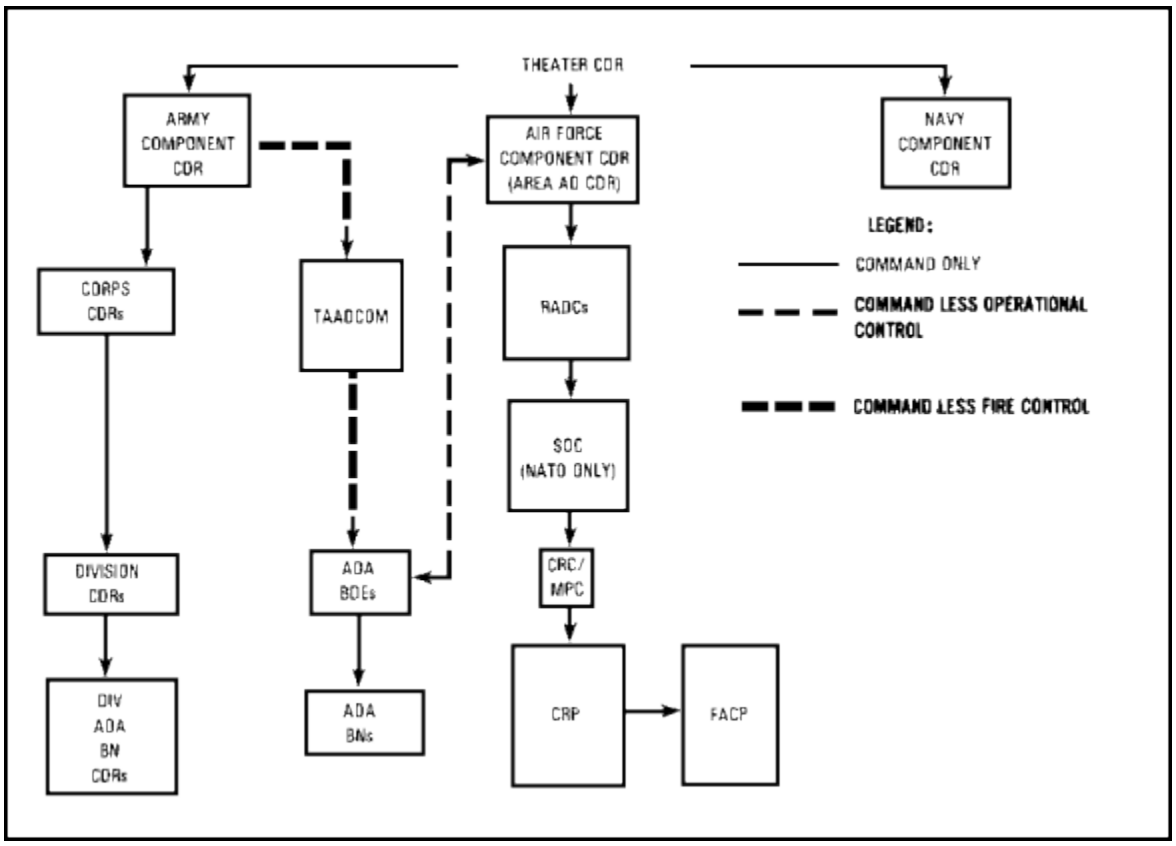

FIGURE 51. THEATER AD COMMAND CHAIN.

Special command statuses are formed by attacking or placing the ADA unit under tactical control, attachment (US, NATO), operational command and operational control (US), operational command (NATO), or operational control (NATO) of another unit. These statuses create special operational, training, administrative, and logistical relationships among the ADA unit, its parent organization, and the receiving unit.

Tactical Control. Tactical control (NATO) is the detailed and usually local direction and control of movements and maneuvers necessary for mission accomplishment. For ADA, tactical control is best defined as fire control. The parent ADA unit commander retains training, administrative, and logistical responsibilities.

Attachment. Attachment (US, NATO) is the temporary placement of a unit within another organization. Subject to the limitations imposed by the attachment order and by the rules and procedures established by the AADC, the commander of the organization receiving an attached ADA element will exercise the same degree of command and control over attached units as he does to units organic to his command. This includes administrative and logistical support. The parent ADA unit commander retains the responsibility for the transfer and promotion of personnel.

Operational Command and Operational Control (US). Operational command and operational control (US) are synonymous terms in a pure US environment. In this special command status, the commander receiving the ADA unit is responsible for--

- Composing subordinate forces.

- Assigning tasks.
- Designating objectives.

The parent ADA unit commander is responsible for--

- Administration.
- Discipline.
- Internal Organization.
- Logistics.
- Training.

Operational Command. Operational command (NATO) is a special command status in which the receiving commander is responsible for--

- Assigning missions or tasks.
- Deploying units.
- Reassigning forces.
- Retaining and delegating tactical control.

The parent ADA unit commander retains responsibility for administration and logistics.

Operational Control. Operational control (NATO) gives the receiving commander responsibility for directing forces for specific missions or tasks usually limited by function, time, or location and for deploying units concerned. (Note that the receiving commander is not responsible for assigning separate employment.)

The parent ADA unit commander retains responsibility for administration and logistics.

The Control Chain

The control chain (Figure 52) is a more complex structure. In a US environment, the theater commander assigns responsibility for overall AD and airspace control to a single commander. This is normally the Air Force component commander who is both the AADC and the area airspace control authority. The AADC manages by coordinating and integrating the entire AD effort within the command. He may create AD regions and appoint a commander for each. The RADC is selected from any service component. He is fully responsible for and has full authority for the AD of his region. The RADC is normally located at the next subordinate command and control facility below the TACC which is a subordinate CRC and MPC. The CRC supervises the surveillance and control activities of subordinate radar elements, provides means for air traffic identification, and directs region AD.

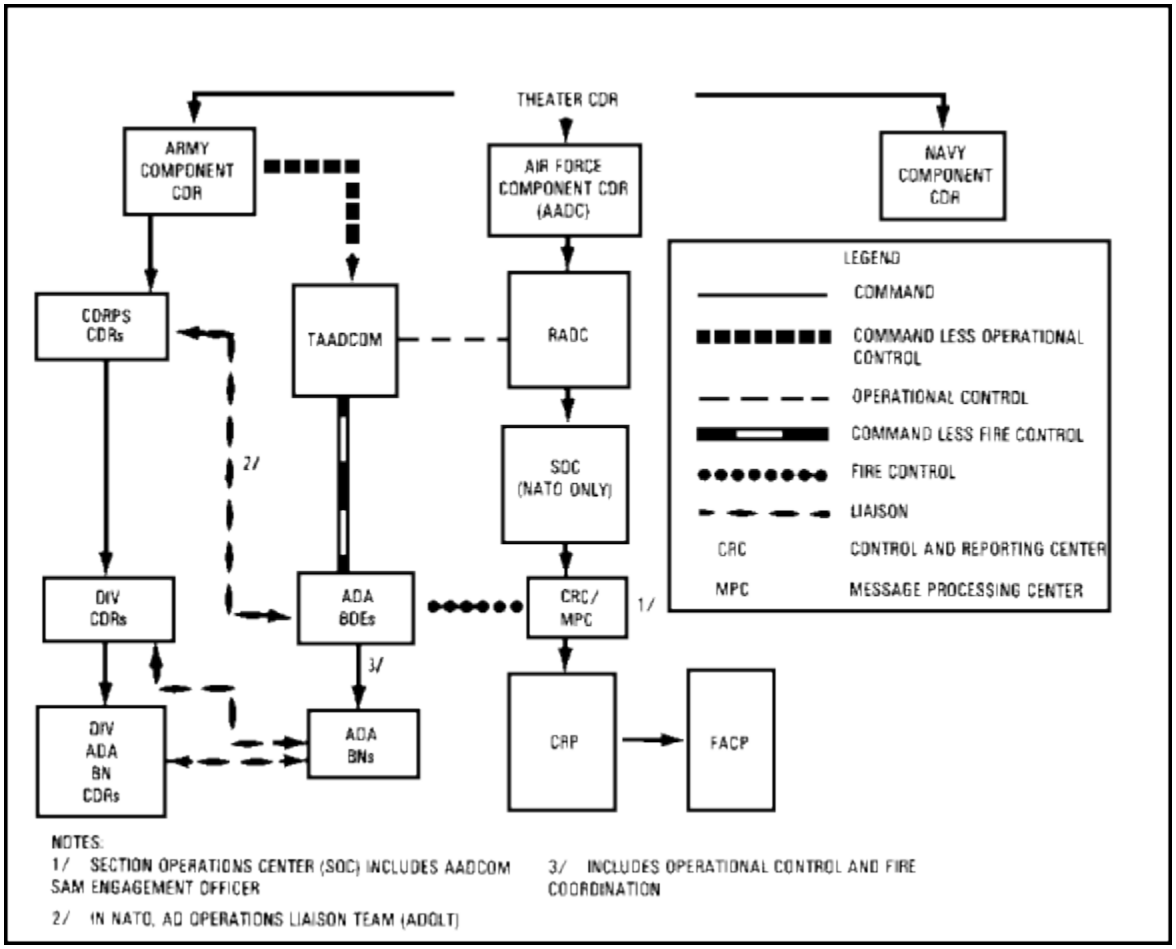

FIGURE 52. THEATER AD CONTROL CHAIN.

In the Army chain, the CRC and MPC control subordinate ADA FDCs from brigade, to battalion, to battery, or individual ADA fire unit.

In certain theaters, an SOC is interposed between the RADC and the CRC and MPC. The sector commander then exercises tactical control over all subordinate elements and ADA brigades. In these theaters, the ADA brigade liaison team provided for the corps is termed the ADOLT. The team acts as a point of coordination between the integrated AD system and the corps conducting operations in the corps area.

When Army AD means are assigned, attached, or organic to Army maneuver elements, they remain subject to area and or region rules of engagement to ensure a coordinated and integrated AD effort. The RADC will normally delegate operational command, less the fire control previously described, of these assigned, attached, or organic Army AD means to the respective maneuver commander. Priorities for these AD resources are developed by the maneuver commander.

ADA headquarters and headquarters elements were formerly known as AADCP, GOCs, and BOCs. These nonstandard terms for Army AD command and control facilities were eliminated. The standard terms for these facilities are--

- CP.

- TOC.
- FDC.

CP

A CP is a unit or subunit headquarters where the commander and staff perform their activities. In combat, the headquarters is often subdivided. The element in which the commander is located or operates is called a CP. It is his principal facility for commanding and controlling combat operations. The term CP replaces the term AADCP. Unlike an AADCP, any ADA echelon from AADCOM to platoon can have a CP.

TOC

A TOC is a subelement of a CP for a headquarters with staff elements (AADCOM, brigade, or battalion). It consists of a physical grouping of the staff elements concerned with current tactical operations and tactical support.

FDC

An FDC is that subelement of brigade and battalion TOCs and battery and platoon CPs where the commander exercises fire direction, fire distribution, and or fire control. The FDC receives target intelligence and fire control orders and translates them into appropriate fire directions and fire distribution. AADCOMs do not have FDCs except when augmented with fire control equipment. Two different fire distribution systems are used at HIMAD FDCs: AN/TSQ-73 and AN/MRC-136.

AN/TSQ-73. The command and control system AN/TSQ-73 (Missile Minder) performs fire distribution functions for Hawk units.

AN/MRC-136. The ICC AN/MRC-136 performs these functions at Patriot units.

The AN/TSQ-73 system is an automated electronic AD command and control system which is capable of operating at battalion and brigade levels. It furnishes information for the command and control of individual fire units (to include control of emissions), coordinates the actions of subordinate command and control systems, and provides an interface with other services. The AN/TSQ-73 contains situation display consoles, radar interface equipment, ADP equipment, and communications equipment. It is capable of providing automatically processed digital information and advanced voice communications.

The battalion level AN/TSQ-73 provides the control and coordination of individual HIMAD fire units. The brigade level AN/TSQ-73 acts as overall activity director, coordinating the actions of subordinate battalion systems and providing command and control interface with other services. Battalion-level AN/TSQ-73s can coordinate the fires of 24 fire units while the brigade-level system can coordinate up to 48 individual fire units. In the absence of a brigade-level system, a battalion AN/TSQ-73 is capable of assuming the brigade-level command and control functions.

Command and control of Patriot fire units is accomplished by the ICC located at the FDC. The ICC is the nerve center of the Patriot battalion's AD operations. The ICC controls the firing batteries and coordinates their activities with those of adjacent battalions and higher headquarters. The ICC is

capable of controlling up to six firing batteries and interfacing with the brigade-level AN/TSQ-73 or the Air Force AN/TSQ-91. Figure 53 illustrates Army ADA command organizations.

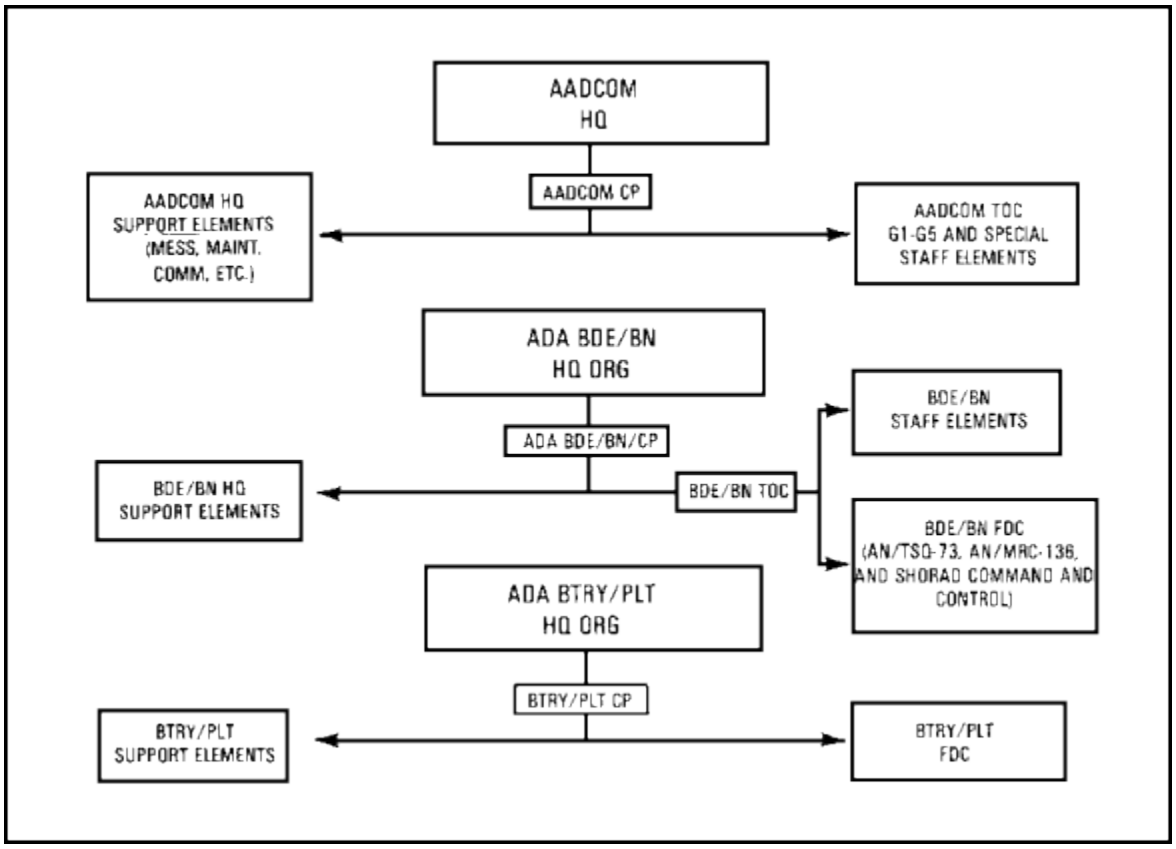

FIGURE 53. ADA COMMAND ORGANIZATIONS.

Organization for Airspace Management

Authority for establishing and coordinating the system for airspace management is also normally vested in the Air Force component commander who is the airspace control authority as well as the AADC. His authority for central airspace management is exercised through the ACC located in the TACC. The ACA subdivides his area into airspace management regions and appoints a region airspace manager who normally exercises his authority through an AMC located within a CRC. Each AMC includes Air Force personnel and an AMLS with ADA and Army aviation personnel. Figure 54 illustrates airspace management linkage and communications.

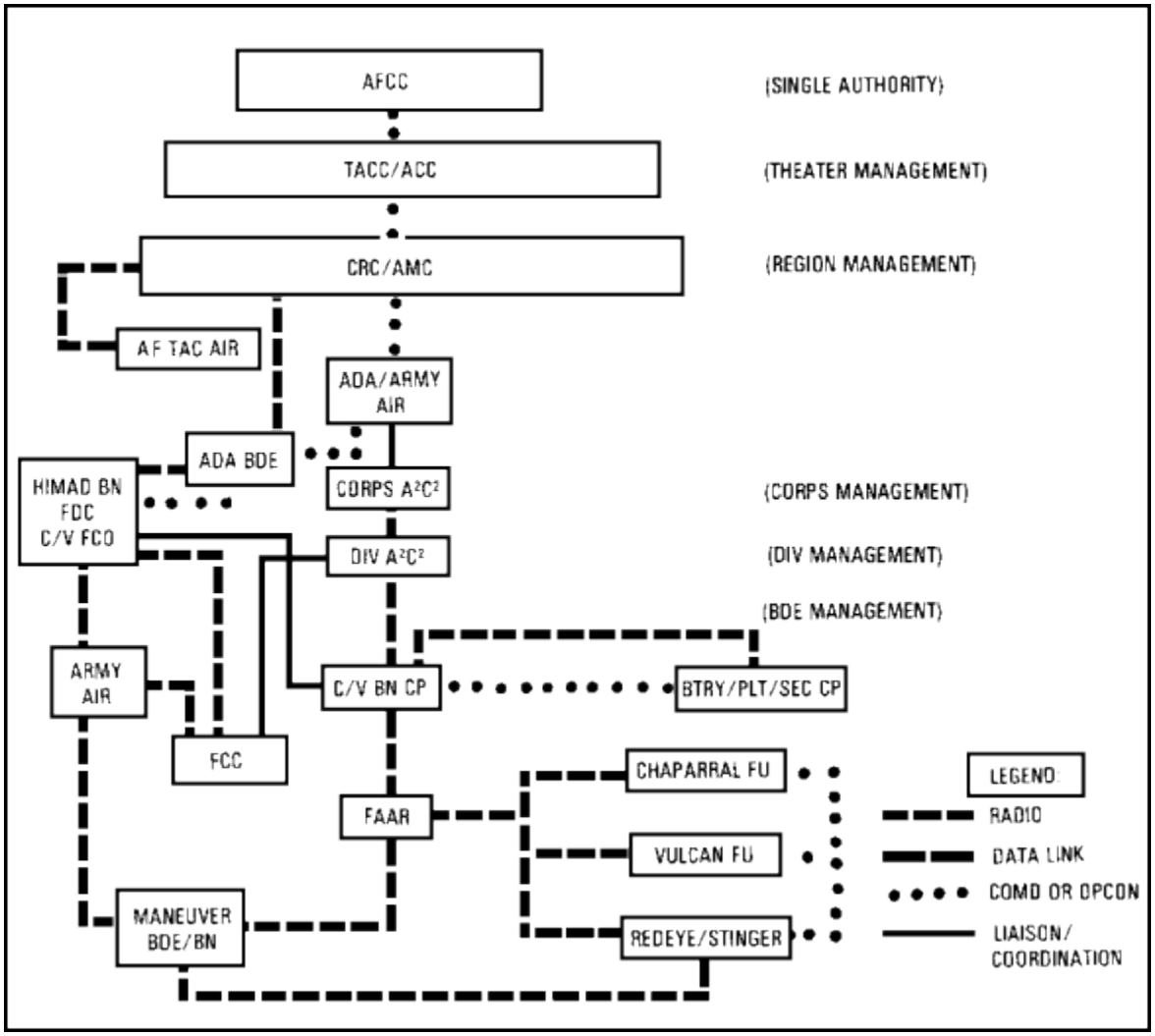

FIGURE 54. AIRSPACE MANAGEMENT LINKAGE AND COMMUNICATIONS.

The forward deployed maneuver brigades maintain an airspace management capability which allows receipt of ADA warning information used by the brigade commander. This capability also includes the means to coordinate the activities of all users of brigade airspace. The area of concern is below the coordinating altitude and deals primarily with the requirements of ADA, aviation, and fire support assets that operate within the brigade airspace.

The corps and division commanders establish an AME under the staff supervision of the G3. The G3 Air supervises the actual operations of the AME. Staffing of the AME will include, but not be limited to, the following:

- ADA officer.
- Aviation officer.
- Air Force liaison officer.
- Fire support coordinator.
- ATC liaison officer.

- Intelligence officer.

At brigade and battalion level, no special staff element exists to perform AME functions. Consequently, such functions are performed by existing staff personnel, supporting liaison and fire support representatives, and subordinate unit commanders on a by-exception basis. Airspace management functions are supervised by the S3 Air. Staffing at this level should conform to division staffing where possible.

The AME is a planning and management element with limited information handling capabilities. The AME determines how the commander's airspace requirements can best be met. User activities and requirements differ between the division and corps rear area and, in this respect, the functions of the AME will differ accordingly.

The AME identifies and resolves potential conflicts concerning the use of airspace through the correlation of airspace. The AME--

- Develops and maintains the airspace utilization map.
- Develops, maintains, and disseminates recommended LLTRs.
- Maintains and disseminates the information on all ROAS, standard-use Army air routes, weapons free zones, preplanned field artillery fires, airmobile operations, major aviation operations, and FARP locations.
- Relays information concerning AD warnings and rules of engagement (WCSs, hostile criteria).
- Monitors the status of AD and aviation assets and advises the commander.
- Maintains and disseminates the status and location of NAVAIDs and landing sites.
- Coordinates and disseminates information concerning the establishment of coordinating altitudes and changes thereto.
- Disseminates information concerning enemy AD activity.
- Coordinates requirements for airfield terminal control zones.
- Provides airspace management information relevant to development of air movement plans, and ensures that airlift requirements are included in airspace utilization annexes.
- Coordinates and disseminates to the ATC and ADA procedures used by aviation units for across FLOT operations to include return procedures.
- Coordinates SIF and IFF procedures for Army aircraft to include the location of the SIF and IFF line.
- Disseminates to FOCs, FCCs, and aviation units any grid matrix systems used to facilitate early warning and SHORAD control.
- Provides information to the FOC and FCC concerning LLTRs; standard-use Army air routes; requirements for NAVAIDs and terminal facilities; restricted areas; weapons free zones; AD WCS; rules of engagement; coordinating altitude; field artillery and ADA fire unit locations;

aviation annex to OPLANs and OPORDs; IFF and SIF codes; and instructions to broadcast air warning for friendly nuclear strikes, CAS strikes, or artillery concentrations.

Further information on airspace management is available in FM 1-103.

The AADC manages the integrated AD through the use of the command and control structures and procedures. The three categories of command and control procedures are--

- Warning procedures and alert statuses.
- ROE.
- Supplemental fire control measures.

Warning Procedures and Alert Statuses

Warning procedures and alert statuses are measures taken to alert, prepare, or increase unit readiness for combat.

DEFCONs. DEFCONs describe progressive alert postures primarily for use between the JCS and the commanders of unified and special commands. DEFCONS are graduated to match situations of varying military severity, and are numbered 5, 4, 3, 2, and 1 as appropriate. In NATO, a similar system of SOAs is used in place of DEFCON.

WADs. WADs describe a progressive system of alert postures based on the DEFCON. They are used by the AADC and or RADC to specify minimum percentages of ADA fire units within parent organizations which are required to be at given SORs. In NATO where DEFCONs are known as SOAs, WADs are termed DEFREPs.

SORs. SORs describe the degree of readiness of ADA fire units expressed in minutes from time of alert notification to time of weapon firing. SORs are based on the WAD and, for HIMAD units, are normally designated by ADA battalion commanders for their subordinate fire units. For SHORAD units, SORs are declared down to battery or combat teams. Additionally, SORs are used to specify personnel manning requirements.

ADWs. ADWs represent the commander's evaluation of the probability of air attack within his area of operations. ADWs are routinely issued by RADCs. They are also issued by any commander for his command. In no case, however, can the local ADW be lower than the overall ADW issued by the RADC. The issuance of an ADW is not tied to any other warning procedure or alert status. Therefore, a commander may issue an ADW for his command irrespectively of DEFCON or WAD. Similarly, ADW is used by a commander to dictate the readiness posture of the ADA units under his command. As an example, a situation might occur where an air attack was not expected for a unit (low DEFCON, WAD, and ADW) but where a forward element of that unit was subjected to air attack. The division commander could declare ADW RED, forcing the ADA units in his command to assume the highest readiness posture regardless of the declared DEFCON.

ADWs replace the obsolete term "ARW." The three ADWs as defined in JCS Pub 1 are--

- ADW RED--Attack by hostile aircraft or missiles is imminent or in progress. This means that hostile aircraft or missiles are within a respective area of operations or are in the immediate vicinity of a respective area of operations with high probability of entry thereto.
- ADW YELLOW--Attack by hostile aircraft or missiles is probable. This means that hostile aircraft or missiles are en route toward a respective area of operations, or unknown aircraft or missiles suspected to be hostile are en route towards, or are within, a respective area of operations.
- ADW WHITE--Attack by hostile aircraft or missiles is improbable. ADW WHITE is declared either before or after ADW YELLOW or ADW RED. The initial declaration of ADE automatically establishes an ADW other than WHITE to enable secure control of air traffic.

ADE. ADE is an emergency condition (declared by either the Commander in Chief, NORAD, or Commander in Chief, ADC) which exists when attack upon CONUS, Canada, or US installations in Greenland by hostile aircraft or missiles is considered probable, is imminent, or is taking place.

ROE

ROE are the positive and procedural management directives issued by competent military authority which specify the circumstances and limitations under which forces will initiate or continue combat engagement with other encountered forces (JCS Pub 1). The AADC establishes ROE to enable him to delegate the authority to engage aircraft and also permit him to retain control of the air battle by prescribing the exact conditions under which engagements are conducted. The seven common components of ROE are as follows:

Right of Self-Defense. The right of self-defense is the responsibility of commanders at all echelons to take whatever action is required to protect their forces and equipment against air attack. Normally, such action is governed by rules and procedures established by the AD commander. Emergency action deemed necessary, if contrary to the established rules, is carefully weighed for its effect on the operations and safety of other friendly forces and, if taken, reported to the appropriate commander at the earliest practicable time.

Hostile Criteria. Hostile criteria are basic rules issued by the commanders of unified or specified commands, and by other appropriate commanders when so authorized, which are used by echelons having identification authority to determine the friendly or hostile character of unknown detected aircraft. Identification authority is normally retained at the AD sector (CRC) level. Upon target detection, fire units having real-time data transmission capability perform target correlation (the determination that an aircraft appearing on a radar scope, on a plotting board, or visually detected is the same vehicle as that on which information is being received from another source), make initial target identification, and report target characteristics to the AD sector commander. The AD sector commander then makes final target identification and delegates engagement authority. Identification authority is also delegated to lower echelons (as is normally the case with fire units having no real-time data transmission capability). Examples of this can include speed, altitude, heading, or other requirements within specified volumes of airspace (see supplemental fire control procedures below), or

visual recognition of specific enemy characteristics or hostile acts. In such cases, individual fire units have both identification and engagement authority.

Level of Control. Level of control describes the AD echelon at which positive management of the air battle is conducted. This can be a TACC, ADOC (NATO only), SOC (NATO only), CRC and CRP, ADA brigade or battalion FDC, or the individual fire unit.

Modes of Control. The two modes of control are centralized control and decentralized control.

Centralized control is the control mode whereby a higher echelon authorizes target engagements to fire units. Permission to engage each track must be requested by the fire unit from that higher AD echelon. Centralized control is used to minimize the likelihood of engaging friendly aircraft while permitting engagements of hostile aircraft only when specific orders are issued to initiate the engagement.

Decentralized control is the normal wartime mode of control for AD whereby a higher echelon monitors unit actions, making direct target assignments to units only when necessary to ensure proper fire distribution, to prevent engagement of friendly aircraft, and to prevent simultaneous engagements of hostile aircraft. Decentralized control is used to increase the likelihood that a hostile aircraft will be engaged in a high-density environment. The lack of positive controls associated with decentralized control is not acceptable during peacetime.

The processes of raising and lowering the echelon at which the air battle is managed are termed "centralizing control" and "decentralizing control," respectively. Air battle management is centralized when it is conducted at battalion level or higher, as long as that echelon has the capability of making direct target assignments to fire units, and higher echelons have the capability of monitoring fire unit actions. For instance, in a situation where air battle management is decentralized to the ADA brigade FDC, the ADA brigade commander exercises centralized control of his subordinate fire units. At the same time, however, higher control echelons are continuously monitoring the actions of the brigade's fire units. These higher echelons are exercising decentralized control while the brigade commander exercises centralized control. Thus, centralized control and decentralized control are conducted simultaneously, although at different levels.

Autonomous Operations. Autonomous control is the mode of operation assumed by a unit after it has lost all communications with higher echelons. The unit commander assumes full responsibility for control of weapons and engagement of hostile targets.

WCSs. WCSs describe the relative degree with which the fires of AD systems are managed. They are applied to weapon systems, volumes of airspace, or types of aircraft. This degree or extent of control will vary depending on the relative priorities of two needs: the need to provide for the protection of friendly aircraft, and the need to maintain a high level of AD for a specific tactical situation. The WCSs are imposed by the AADC or RADC. However, other maneuver commanders (that is, corps, division, brigade, or battalion) have the authority to impose a more restrictive WCS within their areas of operation for assigned, attached, or organic ADA weapons if the local situation so demands. Similarly, these commanders can request the AADC or RADC to impose a less restrictive WCS within their respective areas. The three WCSs are weapons free, weapons tight, and weapons hold.

- Weapons Free. Fire at any aircraft not positively identified as friendly. This is the least restrictive WCS.
- Weapons Tight. Fire only at aircraft positively identified as hostile according to the prevailing hostile criteria. Positive identification is effected by a number of means to include visual identification (aided or unaided) and meeting other designated hostile criteria supported by track correlation.
- Weapons Hold. Do not fire except in self-defense or in response to a formal order. This is the most restrictive WCS.

Fire Control Orders. Fire control orders are commands which are used to control AD engagements on a case-by-case basis, regardless of the prevailing WCS. These commands are most often used by higher control echelons when monitoring the decentralized operations of subordinate units. Fire control orders are transmitted electronically or verbally; however, not all of the fire control orders shown below and in Figure 55 can or will be used by every type of ADA weapon system.

- Engage. This command is used to order a fire unit to engage (fire on) a specific target. This order cancels any previous fire control order which was given on that track.
- Cease Engagement. This command is used to stop tactical action against a specified target and is always followed by an engage command. This order is used to change an ongoing engagement of one target to another of higher priority. Missiles in flight are allowed to continue to intercept. In NATO, this order is used to preclude simultaneous engagement of a target by more than one weapon system. (Does not apply to nonautomated ADA systems or Patriot.) (See Cease Fire.)
- Hold Fire. This is an emergency fire control order used to stop firing and all tactical action to include the destruction of any missiles in flight. It is used to protect friendly aircraft.
- Cease Fire*. This is a command given to ADA units to refrain from firing on, but to continue to track, an airborne object. Missiles in flight are allowed to continue to intercept. It is used to prevent simultaneous target engagement by manned fighters and ADA units. (Does not apply to nonautomated ADA systems.)
- Cover*. This command is used to order a fire unit to assume a posture that will allow engagement of a target if directed. For radar-directed systems, this means achieving a radar lock on a specified target. It is used for targets that are presently engaged by another fire unit or for targets that are not yet a significant threat. Units that receive this command report tracking, lock on, and ready to fire to higher echelons as these statuses are achieved. (Does not apply to nonautomated ADA systems or Patriot.)
- Engage Hold (Patriot only)*. This command is used to temporarily restrain a fire unit from automatically engaging a target. If the fire unit has not fired, target tracking continues. Missiles in flight are allowed to continue to intercept. This command cannot be automatically transmitted from a brigade level AN/TSQ-73 to a Patriot unit at this time.

- Stop Fire*. This is an emergency fire control order to temporarily halt the engagement sequence due to internally unsafe fire unit conditions. It is seldom transmitted outside the fire unit. This command is given by anyone in the fire unit who detects an unsafe condition. The engagement continues after the unsafe condition is corrected.

Note: The commands marked with an asterisk are not currently recognized as fire control orders in some theaters.

FIRE CONTROL ORDER	FIRE UNIT ACTION	
	IF YOU HAVE FIRED —	IF YOU HAVEN'T FIRED —
COVER. EXAMPLE — "FIRE UNIT 36, COVER TRACK 68."	NA	ACHIEVE LOCK ON THE TARGET. UPDATE TARGET TRACK REPORT.
ENGAGE HOLD. EXAMPLE — "FIRE UNIT 36, ENGAGE HOLD, TRACK 68."	ALLOW MISSILE IN FLIGHT TO CONTINUE TO INTERCEPT.	CONTINUE TO TRACK. (PATRIOT ONLY)
ENGAGE. EXAMPLE — "FIRE UNIT 36, ENGAGE TRACK 68."	FIRE AGAIN.	ENGAGE THE TARGET.
CEASE ENGAGEMENT. EXAMPLE — "FIRE UNIT 36, CEASE ENGAGEMENT TRACK 68, ENGAGE TRACK 77."	ALLOW MISSILE IN FLIGHT TO CONTINUE TO INTERCEPT. DO NOT FIRE ADDITIONAL MISSILES. ENGAGE THE NEW TARGET.	DO NOT FIRE AND CEASE TRACKING THAT TARGET. ENGAGE NEW TARGET.
CEASE FIRE. EXAMPLE — "FIRE UNIT 36, CEASE FIRE TRACK 77."	ALLOW THE MISSILE IN FLIGHT TO CONTINUE TO INTERCEPT. DO NOT FIRE ADDITIONAL MISSILES. CONTINUE TO TRACK THE TARGET.	DO NOT FIRE. CONTINUE TO TRACK.
HOLD FIRE. EXAMPLE — "FIRE UNIT 36, HOLD FIRE TRACK 77."	DESTROY MISSILES IN FLIGHT IMMEDIATELY. CEASE TRACKING — PATRIOT CONTINUES TO TRACK.	DO NOT FIRE. CEASE TRACKING.
STOP FIRE. EXAMPLE — "STOP FIRE. ALPHA LAUNCHER SECTION."	ALLOW MISSILE IN FLIGHT TO CONTINUE TO INTERCEPT. DO NOT FIRE ADDITIONAL MISSILES. CONTINUE TO TRACK. ASCERTAIN AND CORRECT THE UNSAFE CONDITION. CONTINUE THE ENGAGEMENT.	DO NOT FIRE. CONTINUE TO TRACK. ASCERTAIN AND CORRECT THE UNSAFE CONDITION. CONTINUE THE ENGAGEMENT.

FIGURE 55. FIRE CONTROL ORDERS.

Supplemental Fire Control Measures

Supplemental fire control measures are procedural management measures issued by competent military authority which delineate or modify hostile criteria, delegate identification authority, or which serve strictly as aids in fire distribution or airspace control. The supplemental fire control measures are as follows:

ADOA. ADOA is an area and the airspace above it within which procedures are established to minimize mutual interference between AD and other operations. It can include designations of one or more of the following:

- AD Action Area. This describes an area and the airspace above it within which friendly aircraft or ADA weapons are normally given precedence in operations except under specified conditions. This type of ADOA is primarily used to minimize mutual interference between friendly aircraft and ADA weapon systems. ADOAs are prioritized for ADA weapons are similar to restricted operations areas for aircraft (see below), except that ADOAs are normally in effect for longer periods of time.
- AD Area. This is specifically defined airspace for which AD is planned and provided. This type of ADOA is primarily used for airspace control, but is also used to define many area within which ADA units are operating.
- ADIZ. This is the airspace of defined dimensions within which the ready identification, location, and control of airborne vehicles are required. This type of area is normally used only for airspace control. Areas within an ADIZ will normally be characterized by extremely stringent hostile criteria and WCSs.

WEZ. WEZ identifies a volume of defined airspace within which a specific type of AD weapon is preferred for use in an engagement. Use of WEZ does not preclude engagement of high-priority targets by more than one type of weapon system if centralized control of each weapon system involved is available. The activation of WEZ is used to delegate identification authority. Commonly used WEZs include--

- FEZ. FEZ is established in an area where no effective surface-to-air capability is deployed.
- HIMEZ. This is normally applied to long-range SAMs. A HIMEZ limits the volume of airspace within which these weapons can conduct engagements without specific direction from the authority establishing the WEZ.
- LOMEZ. LOMEZ is a volume of airspace which establishes control over engagements by low- to medium-altitude SAMs. The same considerations pertinent to the HIMEZ and FEZ apply. Subject to weapon systems capabilities, the LOMEZ normally will extend beyond the FEBA.
- SHORADEZ. This is an area of SHORAD deployment that may fall within a HIMEZ or LOMEZ. It is also possible that some areas are solely defended by SHORAD assets. A SHORADEZ is established to define the airspace within which these assets will operate. Because centralized control over SHORAD weapons may not be possible, these areas are clearly defined and disseminated so that friendly aircraft can avoid them.

ADA engagements within an activated WEZ are conducted by the echelon controlling engagements without further permission or direction from the establishing authority of the WEZ if the targets meet specified hostile criteria in effect outside the activated WEZ. Thus, an activated WEZ supplements ADA hostile criteria and is used by battalion FDCs and fire units to make target assignments and engagement decisions.

HIDACZ. HIDACZ is airspace of defined dimensions in which there is a concentrated employment of numerous and varied airspace users. These can include aircraft; artillery, mortar and naval gunfire; local AD weapons; and surface-to-surface missiles. The HIDACZ is established by the AADC in his capacity as the airspace control authority upon request of ground commanders. A HIDACZ is established when the level and intensity of airspace operations dictate the need for special airspace control measures. The number of such zones will vary depending on the combat situation and the complexities of airspace control in conjunction with fire support coordination. The establishment of a HIDACZ normally will increase temporary airspace restrictions (see below) within the volume of defined airspace. Additionally, establishment of a HIDACZ within a maneuver area will normally give that maneuver unit commander complete WCS authority within the activated HIDACZ.

Temporary Airspace Restrictions. Temporary airspace restrictions are imposed on segments of airspace of defined dimensions in response to specific situations and requirements. These can include CAP operations, air refueling areas, and those areas declared ADA WEAPONS FREE. The issuance of such restrictions will include--

- Identification of the airspace user being restricted.
- Period, area, altitude, and height of restriction.
- Procedures for cancellation or modification of the restriction in event of communications loss.

Three common temporary airspace restrictions are ROAs, MRRs and LLTRs, and standard-use Army aircraft routes.

ROA. This identifies airspace of defined dimensions within which the operation of one or more airspace users is restricted, generally for a short time. These areas are established by the ACA in response to the requests of ground force commanders. Consequently, the maneuver unit commander will normally have complete WCS authority within an activated restricted operations area.

ROAs for aircraft are established to maximize ADA effectiveness. In such cases, the normal ADA WCS is WEAPONS FREE.

ROAs for ADA are established to maximize aircraft effectiveness. In such cases, the normal ADA WCS is WEAPONS HOLD.

MRR and LLTR. This is a temporary corridor of defined dimensions-passing in either direction through ADA defense, a HIDACZ, or an ROA. It is designated to reduce risk to high-speed aircraft transiting the tactical operations area at low altitudes. The WCS for MRR and LLTR is normally maintained at WEAPONS TIGHT. Such circumstances will exist where there is an inadequate timely control capability to permit a more flexible method of AD. However, CAS aircraft transiting the tactical operations area are not required to use an active MRR and or LLTR. This decision is made by

the individual pilot in consideration of flight plan information, MRR and LLTR suitability to mission requirements, degree of acceptable risk necessary for mission success, and CRC recommendations. In such cases where aircraft do not use MRR and or LLTR or where aircraft having nonoperational IFF and SIF transponders do not use MRR and or LLTR, it is recognized that established AD procedures will apply.

The WCS for ADA fire units whose engagement ranges intercept an activated MRR and or LLTR remains at WEAPONS TIGHT for that part of the route. Should it become necessary to change to WEAPONS FREE, the commander who established that particular route will close it.

Standard-use Army aircraft flight routes. These are temporary corridors of defined dimensions passing in either direction through the ROA to designated points in the tactical operations area. These routes will terminate in relatively secure areas. Two points are important for ADA in connection with standard-use routes: (1) Since high-speed aircraft should avoid standard-use routes, ADA hostile criteria may include provisions that high-speed aircraft within these routes are declared hostile. (2) The WCS for ADA units whose engagement ranges intercept an activated standard-use route remains at WEAPONS TIGHT for that part of the route. Should it become necessary to change to WEAPONS FREE, the commander who established that particular route will close it.

Sectors of fire and PTLs are established to assist in the distribution of ADA fires. Sectors of fire are normally designated at battalion after review of fire unit radar coverage diagrams. (In some theaters, sectors of fire are also referred to as battery attack areas or primary target sectors.) Sectors of fire or PTLs for SHORAD are normally designated by the battery commander or platoon leader. These limits are clearly defined by right and left azimuths. Those ADA units with automated tactical data systems must know whether they are to assign and engage air targets within or beyond the stated sector boundaries.

Practice Exercise
Lesson 3

Instructions The following items will test your understanding of the material covered in this lesson. There is only one correct answer for each item. When you have completed the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, review that part of the lesson which contains the portion involved.

1. When required to defend a convoy with Chaparral, why is it best to pre-position them along the march route at critical points?

   - ○ A. The Chaparral carrier cannot maintain convoy speeds.
   - ○ B. Chaparral cannot be fired while carrier is moving.
   - ○ C. It takes a long time to prepare the Chaparral for firing.
   - ○ D. Chaparral crew members can serve as road guides in these areas.

2. M42 Dusters are best employed in _____ strength.

   - ○ A. squad
   - ○ B. section
   - ○ C. battery
   - ○ D. team

3. In an area defense, Hawk coverage is weighted toward the _____ and any exposed unit boundaries.

   - ○ A. FEBA
   - ○ B. rear
   - ○ C. avenue of approach
   - ○ D. defended area

4. The ACA exercises his authority through the airspace _____ center located in the TACC.

   - ○ A. management
   - ○ B. management liaison
   - ○ C. control
   - ○ D. distribution

5. An ADW of _____ means that attack by hostile aircraft is imminent or in progress.

   - ○ A. white
   - ○ B. yellow
   - ○ C. red
   - ○ D. green

6. The _____ battalion commander is the division ADA officer and principal advisor to the division commander on AD matters.

   - ○ A. Hawk
   - ○ B. Patriot
   - ○ C. HIMAD
   - ○ D. SHORAD

7. The process of directing the activities of military forces to obtain an objective is called _____.

   - ○ A. command and control
   - ○ B. command and direction
   - ○ C. operation management
   - ○ D. effectiveness coordination

8. The _____ is a subelement of brigade or battalion TOCs and battery and platoon CPs where the commander exercises fire direction, distribution, and or fire control.

   - ○ A. CP
   - ○ B. TOC
   - ○ C. FDC
   - ○ D. tactical support

9. In all defenses, the Redeye _____ commands his fire units, positions his team, and supervises the distribution of his assets.

   - ○ A. section leader
   - ○ B. squad leader
   - ○ C. platoon sergeant
   - ○ D. platoon leader

10. The _____ system will provide very low- to very high-altitude AD of critical assets.

    - A. Hawk
    - B. Stinger
    - C. Vulcan
    - D. Patriot

11. The _____ describe the progressive alert postures primarily for use between the Joint Chiefs of Staff and the commanders of unified unofficial commands.

    - A. DEFCONs
    - B. WADs
    - C. ROE
    - D. SORs

12. Which of the following describe the relative degree with which the fires of AD systems are managed?

    - A. ADWs.
    - B. SORs.
    - C. ADEs.
    - D. WCSs.

13. There are how many versions of the Vulcan ADA weapon system?

    - A. Two.
    - B. Four.
    - C. Six.
    - D. Eight.

14. What is one of the capabilities that the Stinger missile system has that the Redeye does not?

    - A. Man-portable.
    - B. Shoulder-fired.
    - C. IFF.
    - D. Ability to provide low-altitude AD.

15. In a critical asset weighted defense, the Patriot system provides _____ coverage against threat aircraft.

- ○ A. 90^{o}
- ○ B. 120^{o}
- ○ C. 180^{o}
- ○ D. 360^{o}

16. Which of the following is described as airspace of defined dimensions in which there is concentrated employment of numerous and varied airspace users?

- ○ A. HIDACZ.
- ○ B. Congested airspace activity area.
- ○ C. Restricted air operations zone.
- ○ D. MRRs.

17. The _____ is a zone established in an area where no effective surface-to-air capability is deployed.

- ○ A. WEZ
- ○ B. FEZ
- ○ C. HIMEZ
- ○ D. LOMEZ

18. The _____ represent the commander's evaluation of the probability of air attack within his area of operations.

- ○ A. ADWs
- ○ B. SORs
- ○ C. DEFCONs
- ○ D. WADs

19. Under which method of control does a higher echelon authorize target engagement?

- ○ A. Decentralized.
- ○ B. Centralized.
- ○ C. Autonomous.
- ○ D. Internal.

20. The _____ are real-time commands used to control AD engagements on a case-by-case basis, regardless of the prevailing WCS.

- A. readiness orders
- B. combat directives
- C. WCSs
- D. fire control orders

21. The _____ is an area and the airspace above it within which procedures are established to minimize mutual interference between AD and other operations.

- A. ADOA
- B. AD action area
- C. high-density fire zone
- D. ADIZ

LESSON 3

PRACTICE EXERCISE ANSWERS

1. When required to defend a convoy with Chaparral, why is it best to pre-position them along the march route at critical points?

a. The Chaparral carrier cannot maintain convoy speeds.
b. Chaparral cannot be fired while carrier is moving.
c. It takes a long time to prepare the Chaparral for firing.
d. Chaparral crew members can serve as road guides in these areas.

2. M42 Dusters are best employed in _____ strength.

a. squad
b. section
c. battery
d. team

3. In an area defense, Hawk coverage is weighted toward the _____ and any exposed unit boundaries.

a. FEBA
b. rear
c. avenue of approach
d. defended area

4. The ACA exercises his authority through the airspace _____ center located in the TACC.

a. management
b. management liaison
c. control
d. distribution

5. An ADW of _____ means that attack by hostile aircraft is imminent or in progress.

a. white
b. yellow
c. red
d. green

6. The _____ battalion commander is the division ADA officer and principal advisor to the division commander on AD matters.

a. Hawk
b. Patriot
c. HIMAD
d. SHORAD

7. The process of directing the activities of military forces to obtain an objective is called _____.

a. command and control
b. command and direction
c. operation management
d. effectiveness coordination

8. The _____ is a subelement of brigade or battalion TOCs and battery and platoon CPs where the commander exercises fire direction, distribution, and or fire control.

a. CP
b. TOC
c. FDC
d. tactical support

9. In all defenses, the Redeye _____ commands his fire units, positions his team, and supervises the distribution of his assets.

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b. squad leader
c. platoon sergeant
d. platoon leader

10. The _____ system will provide very low- to very high-altitude AD of critical assets.

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c. Vulcan
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b. WADs
c. ROE
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b. SORs.
c. ADEs.
d. WCSs.

13. There are how many versions of the Vulcan ADA weapon system?

a. Two.
b. Four.
c. Six.
d. Eight.

14. What is one of the capabilities that the Stinger missile system has that the Redeye does not?

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b. Shoulder-fired.
c. IFF.
d. Ability to provide low-altitude AD.

15. In a critical asset weighted defense, the Patriot system provides _____ coverage against threat aircraft.

a. 90^{o}
b. 120^{o}
c. 180^{o}
d. 360^{o}

16. Which of the following is described as airspace of defined dimensions in which there is concentrated employment of numerous and varied airspace users?

a. HIDACZ.
b. Congested airspace activity area.
c. Restricted air operations zone.
d. MRRs.

17. The _____ is a zone established in an area where no effective surface-to-air capability is deployed.

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b. FEZ
c. HIMEZ
d. LOMEZ

18. The _____ represent the commander's evaluation of the probability of air attack within his area of operations.

a. ADWs
b. SORs
c. DEFCONs
d. WADs

19. Under which method of control does a higher echelon authorize target engagement?

a. Decentralized.
b. Centralized.
c. Autonomous.
d. Internal.

20. The _____ are real-time commands used to control AD engagements on a case-by-case basis, regardless of the prevailing WCS.

a. readiness orders
b. combat directives
c. WCSs
d. fire control orders

21. The _____ is an area and the airspace above it within which procedures are established to minimize mutual interference between AD and other operations.

a. ADOA
b. AD action area
c. high-density fire zone
d. ADIZ

LESSON 4

ADA ORGANIZATIONS

TASK

This lesson does not specifically relate to enlisted or officer tasks, but provides general information on the structure of US Army AD organizations.

CONDITIONS

Use only this lesson material to complete the examination.

STANDARDS

You must attain a grade of 70 percent or more on the examination to receive credit for this subcourse.

REFERENCES

The following references are sources for additional information. You do not need them to complete this lesson.

FM 44-1
FM 44-2
FM 44-3
FM 44-15
FM 44-15-1
FM 44-90
FM 44-90-1

Learning Event 1:
ORGANIZATIONAL STRUCTURES

AD is defined in JCS Pub 8 as "all measures designed to nullify or reduce the effectiveness of attack by hostile aircraft or guided missiles after they are airborne."

All US services and allied forces have an AD capability. However, no single element has enough AD weapons to ensure complete AD against a threat having a large, modern air force. For this reason, the fires of all AD weapons within a force are integrated into an overall AD operation under direction of a single AD commander. An integrated AD ensures that AD weapons are employed to achieve effectiveness against enemy aircraft without hindering friendly air operations.

No single commander can personally control or direct the fires of thousands of AD weapons of various types and capabilities; therefore, routine direction is normally delegated to subordinate commanders. However, all systems operate under the AD rules and procedures established by the single AD commander. This provides for an integrated AD within the force while still allowing subordinate commanders to provide AD for their critical assets or areas.

AD organizational structures are designed to facilitate the integration and mixing of AD weapon systems in the AirLand battle.

As with the other Army branches, ADA is undergoing a transition phase. Many new and improved ADA systems are being introduced into the Army inventory, and doctrine to support forces on the modern battlefield is evolving. This has resulted in the creation of new organizations as older ones are either phased out or modified. During this transition period, all types of ADA units are available. This block of instruction introduces these ADA organizations as well as the overall AD organization in various situations. Emphasis is on how units are organized rather than the capabilities of their weapon systems.

Learning Event 2:
TAADCOM

In large theaters, a TAADCOM (TOE 44-1H) is normally provided to support the theater AD commander in accomplishing his AD responsibilities. All Army ADA units not organic or specifically assigned to corps and divisions are normally assigned to the TAADCOM. As explained in Lesson 3, the theater army commander exercises command (less operational command) of the TAADCOM. Operational command is vested in the AADC. The TAADCOM headquarters is basically organized in accordance with TOE 44-1. However, a TAADCOM is tailored to meet the AD requirements of the force deployed in each theater of operations. A type of TAADCOM is shown in Figure 56.

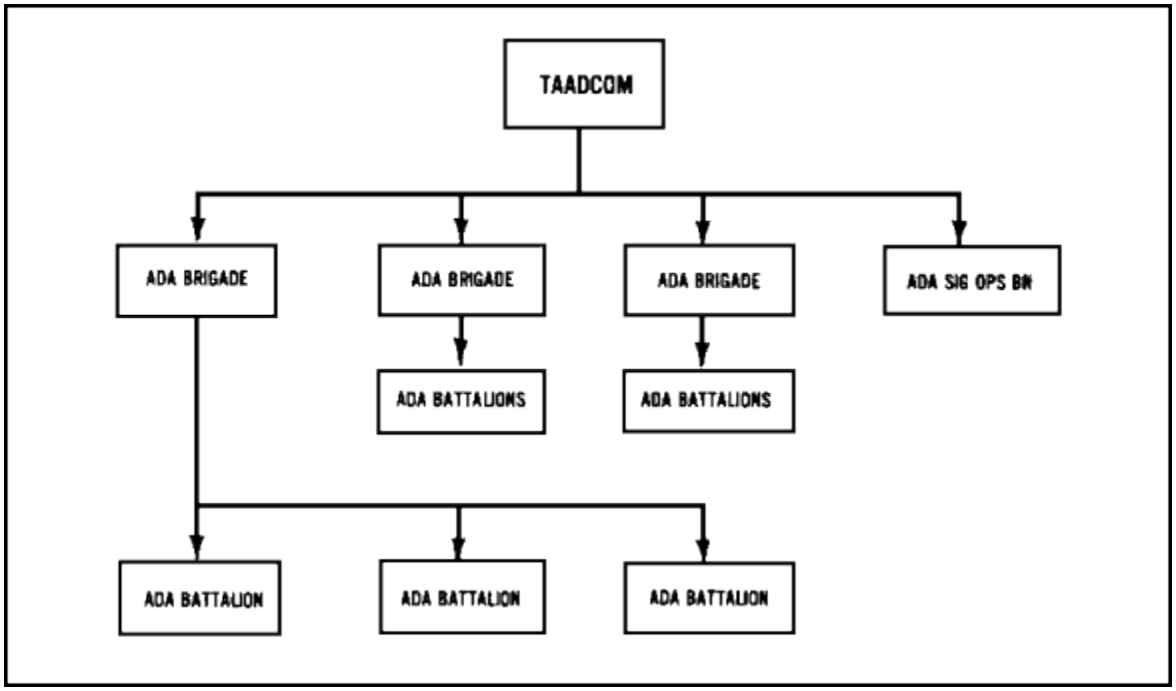

FIGURE 56. TAADCOM ORGANIZATION.

The mission of TAADCOM is to command TAADCOM forces in accordance with the theater commander's guidance, thereby accomplishing the ADA mission within the capability of TAADCOM force. TAADCOM accomplishes this mission by using the following methods.

- Exercising command, less operational control, of US ADA organizations not organic to corps or divisions.
- Planning for and coordinating AD support within the guidelines given by the AADC or RADC for critical assets in the COMMZ and rear combat zone. This includes the use of passive AD measures (camouflage, dispersion, decoys, obscurants, et cetera), as well as the deployment of ADA weapons.
- Planning for and supervising personnel, administrative, and logistical support to nondivisional and noncorps US ADA forces in the theater, to include reconstituting combat power in accordance with mission priorities. Availability, location, and combat readiness of AADCOM assets are provided by automated management systems located both at command headquarters and at subordinate elements.
- Establishing and ensuring continuous operation of a highly automated, digital, data-based command, control, and communications system throughout the area of ADA employment.
- Establishing requirements for and planning the allocation of ADA-related PWRMS.
- Providing, when augmented, liaison to senior ground force and AD elements.
- Providing tactical and technical data to various interfacing agencies as required.

Currently, the only deployed TAADCOM is the 32nd AADCOM in Europe. Operational command of that force is exercised by the Commander, 4th Allied Tactical Air Force. The 32nd AADCOM headquarters is tailored as shown in Figure 57.

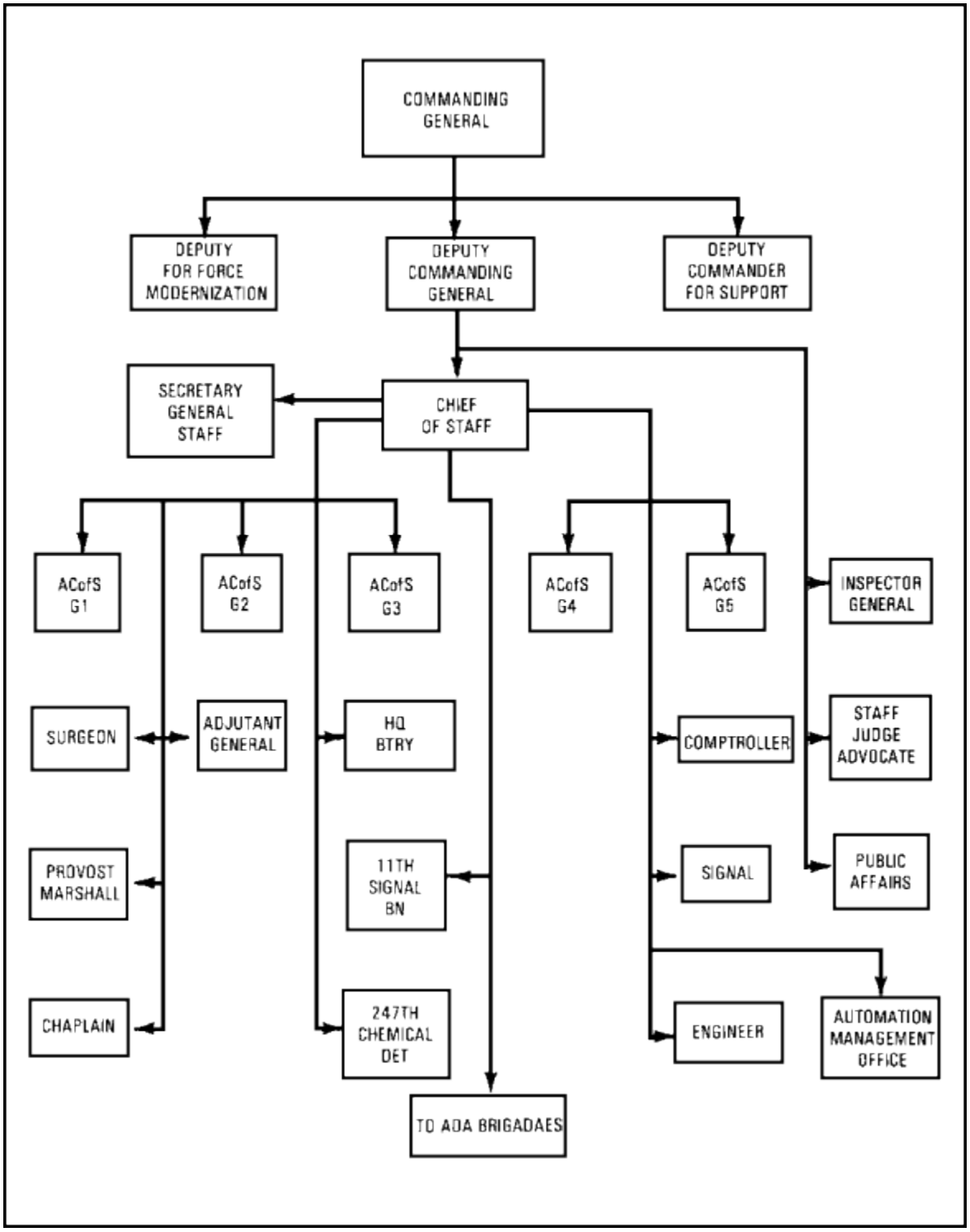

FIGURE 57. ORGANIZATION OF THE 32nd AADCOM.

The AADC and or RADC assigns tactical missions and AD priorities to the TAADCOM commander who tasks, organizes, and deploys ADA forces accordingly. AD operations are conducted in accordance with joint and combined force rules and procedures issued by the AADC and or RADC.

ADA Brigades

ADA brigades (TOE 44-2H) command and coordinate the operations of ADA battalions and other assigned or attached units. They may be assigned to a corps, to a TAADCOM, or to other major headquarters. An ADA brigade may replace a TAADCOM in a smaller theater of operations or in a theater in which a limited number of ADA units are available or required. In these cases, responsibilities of the brigade commander are essentially the same as those of a TAADCOM commander.

When assigned to TAADCOM, the brigade commander usually exercises command (less tactical control) of the ADA units assigned to his organization. However, tactical control may be retained (subject to theater AD rules and procedures) if the theater AADC and or RADC delegates operational control of the brigade to a ground force commander. This is appropriate if the mission of the brigade is to defend maneuver force assets. When assigned or attached to a maneuver force (that is, corps), the brigade commander normally acts as the force AD officer.

The composition of an ADA brigade is tailored based on the mission. In a large theater, the ADA units assigned to a brigade may be of the same type (that is, a "pure" Hawk brigade) to facilitate command and control. However, if the mission requires a mix of SHORAD and HIMAD weapons, brigades are so organized. The basic organization of an ADA brigade is illustrated in Figure 58.

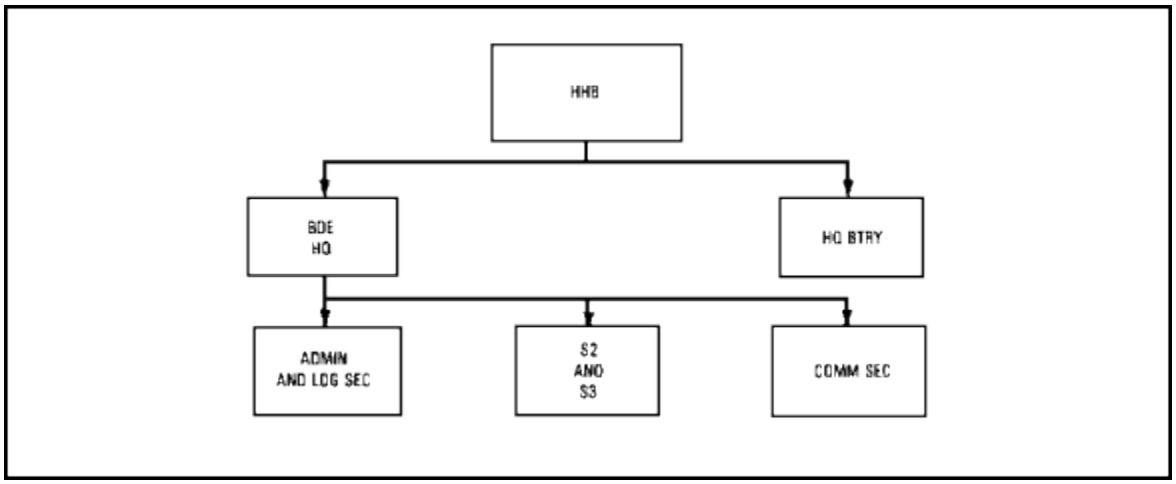

FIGURE 58. ADA BRIGADE (BASIC ORGANIZATION).

This organization can be augmented by specialized teams from TOE 44-520 (see TOE 44-520, Teams, pages 3-14 and 3-15) to accomplish various operational tasks and perform required coordination. These include--

- Controlling AD fires by use of fire distribution systems.
- Providing target information by use of an early warning radar.
- Providing the AMLS to the AD section of an Air Force control and reporting section.
- Providing the AD element to the AME of the corps TOC.

Learning Event 3:
HIMAD MISSILE BATTALIONS

Hawk

Hawk AD units provide LOMAD for organizations and installations. Hawk organizations in the current Army force structure still call for battalions of either three or four firing batteries. Every Hawk firing battery consists of two AFPs and a battery headquarters. The Hawk unit organic to the corps ADA brigade is a 3 x 2 battalion. It consists of an HHB and three firing batteries, each of which has two AFPs. The Hawk unit organic to the theater army is a 4 x 2 battalion. It consists of an HHB and four firing batteries, each of which has two AFPs.

The corps and theater configurations do not provide the firing batteries with organic medium- to high-altitude acquisition radars. The fire units must rely on outside sources (AN-TSQ-73 or AWACS) and the CWAR for target acquisition data. The organization of the units is shown in Figure 59.

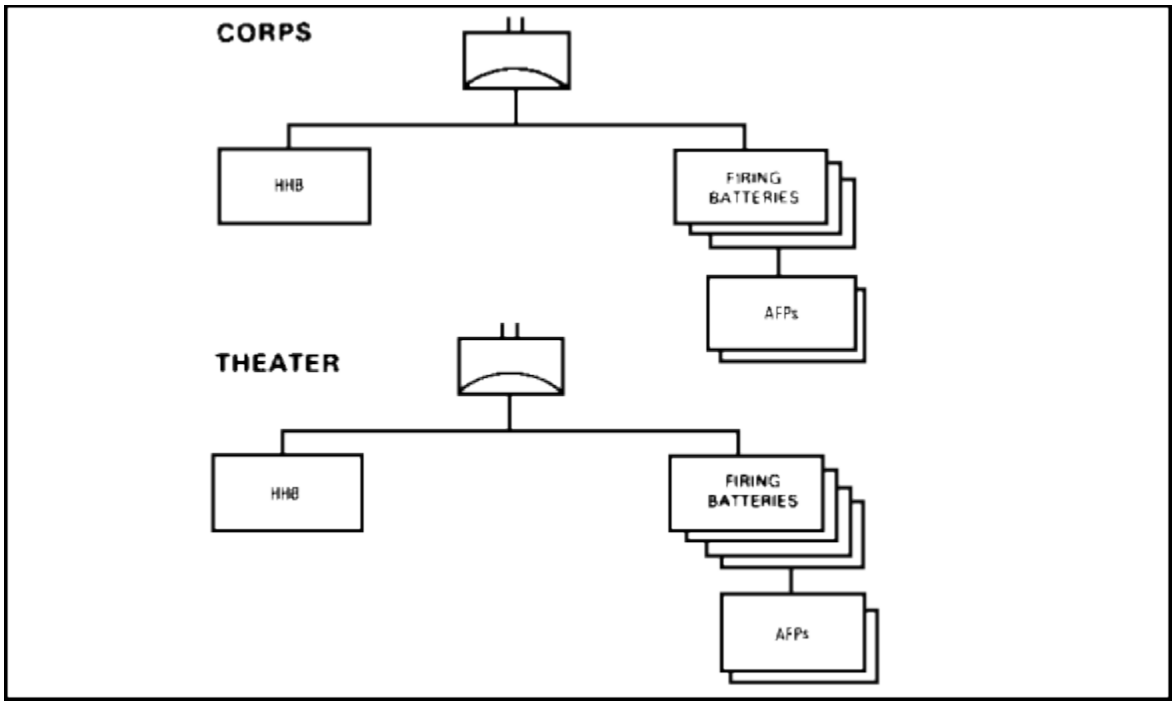

FIGURE 59. CORPS AND THEATER HAWK BATTALIONS.

Patriot

The role of Patriot is to provide very low- to very high-altitude AD of high-value assets and ground combat forces. Patriot's fast-reaction capability, high firepower (ability to engage several targets simultaneously), and ability to operate in a severe ECM environment are features necessary for effective AD on the modern battlefield.

The Patriot battalion is normally assigned to an ADA brigade. It is usually employed by the AADC and or RADC to defend theater assets but may be assigned to support maneuver forces. A Patriot battalion is usually employed in at least battalion strength. However, the Patriot battery is the fire unit.

The battalion (Figure 60) consists of an HHB and six firing batteries. The HHB provides command and control, a technical supply facility, missile resupply, and DS maintenance of communications-electronics, IFF, and engineer equipment. It also furnishes medical and multichannel communications relay support for the battalion. The battery headquarters has sufficient equipment to form a Stinger team.

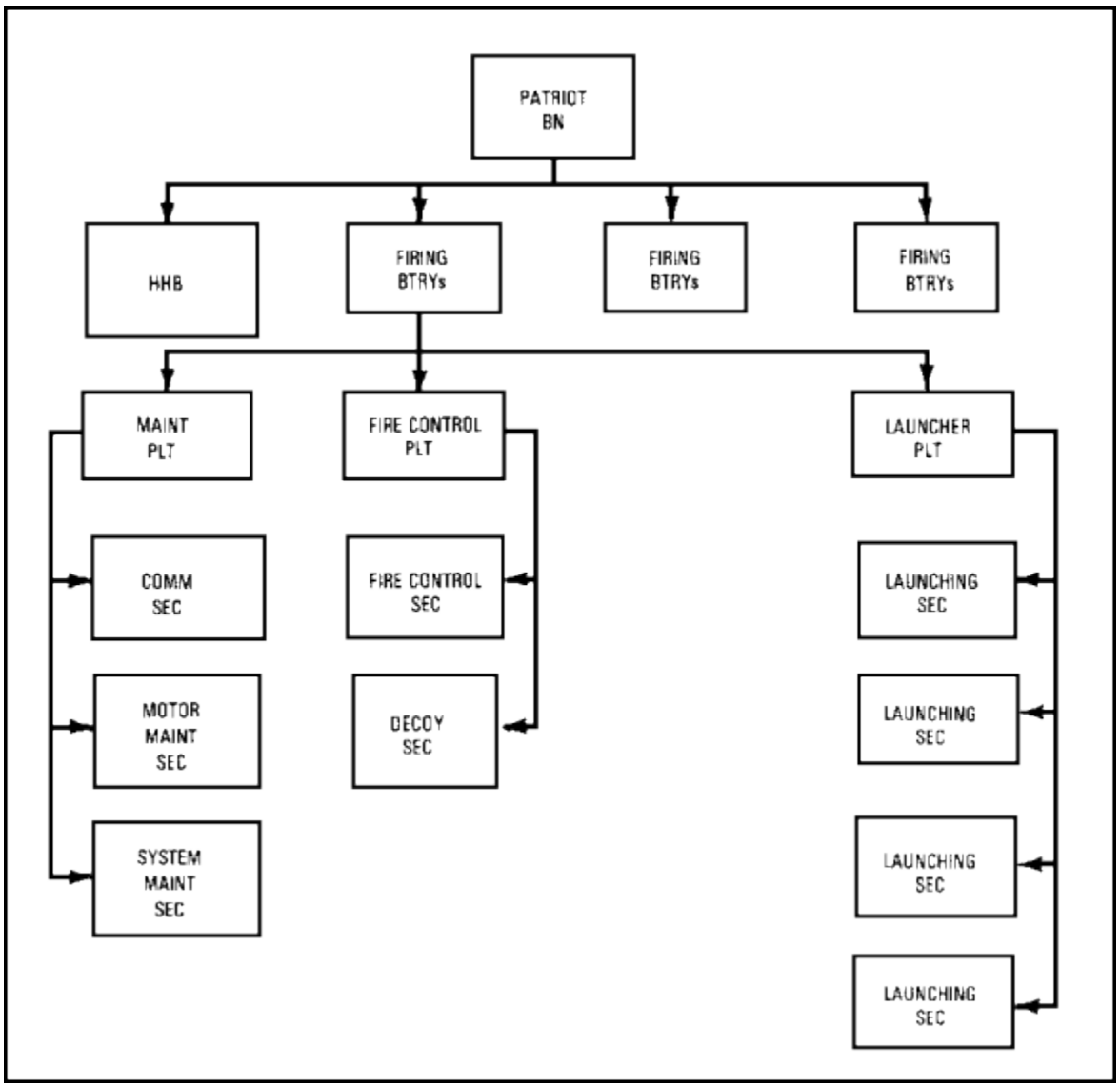

FIGURE 60. PATRIOT BATTALION ORGANIZATION.

The Patriot firing battery includes a battery headquarters, maintenance platoon, fire control platoon, and a launcher platoon. The maintenance platoon has three separate sections--one for system maintenance, one for communications, and the other for vehicle maintenance. The fire control platoon is composed of a fire control section and a decoy section. The launcher platoon has four launching sections, each with two launchers per section. In addition, the launcher platoon headquarters and fire control platoon headquarters have sufficient equipment to form Stinger teams.

Learning Event 4:
SHORAD ARTILLERY BATTALIONS

SHORAD weapons are primarily used for the defense of the ground commander's forces and assets. However, they are also employed to defend theater assets such as air bases. Most SHORAD units are organic to divisions and consist of combinations of short-range guns and man-portable missile systems. At the present time, both new SHORAD systems and product improvements to existing systems are being introduced into the Army. In some cases this has resulted in the reorganization of some SHORAD units to support the Army of the 1980s and 1990s.

C/V Battalion

The Chaparral and SP Vulcan battalion is the organic ADA battalion for AIM infantry divisions and is the most common of the SHORAD battalions.

Besides an HHB, the battalion has four SP firing batteries--two Vulcan and two Chaparral. Each firing battery is organized with a headquarters section, three Chaparral or Vulcan platoons, and a Stinger platoon. Each C/V platoon has 4 weapon squads for a total of 12 in the battery and 48 (24 Vulcan and 24 Chaparral) in the battalion. Each Stinger platoon is composed of four sections containing from three to five Stinger teams. The HHB has a radar platoon consisting of eight FAARs to provide early warning.

Light Division ADA Battalion

The light division ADA battalion counters the low-altitude air threat against the light division. The battalion is capable of quickly accepting augmentation from the corps ADA brigade in the event the division is deployed to a high-intensity conflict. Personnel and equipment are rapidly air transported to support contingency operations. The battalion is organized with an HHB and two Gun and Stinger batteries. Each firing battery has two FAARs. The Gun and Stinger batteries have three PIVADS platoons. Each PIVADS platoon has 3 guns, for a total of 18 for the battalion. Each Stinger platoon has four sections of 5 crews each, for a total of 40 Stinger crews for the battalion.

Airborne Division ADA Battalion

The airborne division ADA battalion is organized with an HHB and four towed Vulcan and Stinger batteries. All equipment is airlanded or, if necessary, dropped by parachute. Each towed Vulcan battery has three Vulcan platoons and a Stinger platoon. Each Vulcan platoon has four guns, while the Stinger platoon has four Stinger sections. Eight FAARs are assigned to the radar platoon in the headquarters battery.

Air Assault Division ADA Battalion

The air assault division ADA battalion is organized into an HHB and three PIVADS and Stinger batteries. Each battery consists of three platoons of towed PIVADs, with each platoon having three guns. The Stinger platoon consists of four sections with five teams each. Four FAARs are assigned to the radar platoon in the headquarters battery. All equipment is air transportable and is displaced by UH-60 and CH-47 helicopters.

M42 (DUSTER) ADA Battalions

National Guard Duster battalions are assigned to support National Guard and Reserve divisions when federalized. The battalion is organized with an HHB (containing early warning radars) and four firing batteries. Each firing battery has four Duster platoons. There are 4 Dusters in each platoon for a total of 16 in the battery and 64 in the battalion.

Learning Event 5:
NONDIVISIONAL SHORAD UNITS

Nondivisional C/V Battalion

The mission of a nondivisional C/V battalion is to provide AD for corps and theater combat elements or installations against attack by low-altitude hostile aircraft and to destroy surface targets as required. The organization is essentially the same as the division C/V battalion with the exception that the gun batteries have towed Vulcans rather than SP Vulcans. The firing batteries of nondivisional C/V assigned to NATO were reorganized into three gun and missile batteries, each having eight towed Vulcans and eight SP Chaparrals. This modified organization has only six FAARs rather than the eight that are available in AIM divisions.

FAAR Augmentation Teams

Separate brigade and armored cavalry regiment SHORAD batteries are normally augmented by FAAR teams. Each team consists of three FAARs and the necessary personnel and equipment to operate them.

Corps AD Element

Because ADA forces are allocated to the corps based on an operational need, there is a continuous requirement for the corps to have an assigned ADA element on the staff. Corps assets, such as nuclear delivery means, logistic complexes, artillery, and command and control facilities, are high-priority targets for the enemy that are provided AD protection. The planning and coordination necessary to ensure that these assets are protected require ADA expertise and a dedicated staff element. The corps obtains this staff element in one of two ways: (1) An ADA brigade that is assigned or attached to the corps will provide an AD element to the corps. The ADA brigade commander is the corps AD officer. (2) A corps that does not have an ADA brigade assigned or attached should augment its headquarters and headquarters company with an AD element from TOE 44-520.

When an ADA brigade not assigned or attached to a corps receives a tactical mission to support the corps, or is positioned within the corps area without a tactical mission to support the corps, its commander becomes an AD advisor to the corps commander. Functions of the corps AD element include--

- Advising the corps commander on corps AD needs and acting as his agent in negotiating for the resources required.

- Acting as interface between the corps and ADA forces of subordinate divisions and also interfacing with theater-level AD forces on corps ADA matters.
- Providing ADA expertise to corps staff members.
- Providing ADA representation to the corps AME.

ADA Signal Operations Battalion

The mission of the ADA signal operations battalion is to provide signal communications support for a TAADCOM with three to five assigned or attached ADA brigades. The battalion is normally assigned to a TAADCOM and consists of a headquarters and headquarters detachment, a command signal operations company, and up to five brigade signal operating companies (one for each brigade assigned to the TAADCOM). The battalion provides--

- A low-capability, multichannel communications system and repeater facilities for telephone, teletype, and data channels between the TAADCOM and the brigades to include lateral systems between brigades.
- A command communications center.
- FM radios for operation of the battalion command and SYSCON nets and to provide initial lineup for the multichannel communications system.

Practice Exercise
Lesson 4

Instructions The following items will test your understanding of the material covered in this lesson. There is only one correct answer for each item. When you have completed the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, review that part of the lesson which contains the portion involved.

1. All Army ADA units not organic or specifically assigned to corps and divisions are normally assigned to _____.

   - ○ A. COMDOR
   - ○ B. RADAC
   - ○ C. TAADCOM
   - ○ D. TIDCOM

2. Which is the only deployed TAADCOM?

   - ○ A. 16th AADCOM.
   - ○ B. 21st TAADCOM.
   - ○ C. 28th TAADCOM.
   - ○ D. 32nd AADCOM.

3. How many firing batteries make up a Patriot battalion?

   - ○ A. Two.
   - ○ B. Four.
   - ○ C. Six.
   - ○ D. Eight.

4. Which platoon in a Patriot firing battery includes a decoy section?

   - ○ A. Headquarters.
   - ○ B. Maintenance.
   - ○ C. Fire control.
   - ○ D. Launcher.

5. An ADA signal operations battalion consists of up to how many brigade signal operating companies?

- ○ A. Three.
- ○ B. Four.
- ○ C. Five.
- ○ D. Six.

PRACTICE EXERCISE ANSWERS

1. All Army ADA units not organic or specifically assigned to corps and divisions are normally assigned to _____.

a. COMDOR
b. RADAC
c. TAADCOM
d. TIDCOM

2. Which is the only deployed TAADCOM?

a. 16th AADCOM.
b. 21st TAADCOM.
c. 28th TAADCOM.
d. 32nd AADCOM.

3. How many firing batteries make up a Patriot battalion?

a. Two.
b. Four.
c. Six.
d. Eight.

4. Which platoon in a Patriot firing battery includes a decoy section?

a. Headquarters.
b. Maintenance.
c. Fire control.
d. Launcher.

5. An ADA signal operations battalion consists of up to how many brigade signal operating companies?

a. Three.
b. Four.
c. Five.
d. Six.

ABBREVIATIONS AND ACRONYMS

AA	antiaircraft
AADC	Area Air Defense Commander
AADCOM	Army Air Defense Command(er)
AADCP	Army Air Defense Command Post
A^2C^2	Army airspace command and control
ACA	airspace control authority
ACC	airspace control center
ACofS	Assistant Chief of Staff
AD	air defense
ADA	air defense artillery
ADC	Aerospace Defense Command
admin	administration
ADE	air defense emergency
ADIZ	air defense identification zone
ADOA	air defense operations area
ADOC	air defense operations center
ADOLT	air defense operations liaison team
ADP	automatic data processing
ADW	air defense warning
AF	Air Force
AFCC	Air Force component commander
AFP	assault fire platoon
AIM	armored, infantry, and mechanized
AMC	airspace management center
AME	airspace management element
AMLS	airspace management liaison section
APU	auxiliary power unit
ARM	antiradiation missile

ARW air raid warning
ASM air-to-surface missile
ASP ammunition supply point
ATC air traffic control
ATGM antitank guided missile
avg average
AWACS airborne warning and control system

bde brigade
BCU battery coolant unit
bn battalion
BOC battalion operations center
btry battery

CAME corps airspace management element
CAP combat air patrol
CAS close air support
CBU cluster bomb unit
Cdr commander
CFA covering force area
cm centimeter
comd command
comm communications
COMMZ communications zone
CONUS Continental United States
COSCOM corps support command
CP command post
CRC control and reporting center
CRP control and reporting post
C/V Vulcan/Chaparral
CWAR continuous-wave acquisition radar

DAME	division airspace management element
DEFCON	defense readiness condition
DEFREP	defense readiness posture
det	detachment
div	division
DIVARTY	division artillery
DS	direct support
ECCM	electronic counter-countermeasures
ECM	electronic countermeasures
ECS	engagement control station
ESJ	escort jammer
est	estimate
etc.	etceteras
EW	electronic warfare
FAAR	forward area alerting radar
FACP	forward air control post
FARP	forward area rearming and refueling point
FCC	flight control center
FCO	fire coordination officer
FDC	fire direction center
FEBA	forward edge of the battle area
FEZ	fighter engagement zone
FLIR	forward-looking infrared
FLOT	forward line of own troops
FM	frequency modulated
FOC	flight operations center
ft	feet or foot
FU	fire unit

G3 Assistant Chief of Staff, G3, Operations
gal gallon
GOC group operations center
GS general support
GS-R general support-reinforcing

HE high explosive
HHB headquarters and headquarters battery
HIMAD high- to medium-altitude air defense
HIMEZ high-altitude missile engagement zone
HIPIR high-powered illuminator radar
HQ headquarters
hr hour

ICBM intercontinental ballistic missile
ICC information coordination central
IFF identification, friend or foe
in inch
IPD Institute for Professional Development
IR infrared

JCS Joint Chiefs of Staff

kg kilogram
km kilometer
kmph kilometers per hour

LAB low-altitude bombing
lb pound
LLTR low-level transit route

log	logistics
LOMAD	low- to medium-altitude air defense
LOMEZ	low-altitude missile engagement zone
LRA	long-range aviation
LS	launching station
m	meter
maint	maintenance
MANPAD	man-portable air defense
MBA	main battle area
METT-T	mission, enemy, terrain, troops, and time available
mi	mile
mm	millimeter
MPC	message processing center
MRR	minimum risk route
msl	missile
NATO	North Atlantic Treaty Organization
NAVAID	navigational aid
NBC	nuclear, biological, chemical
No.	number
NOE	nap-of-the-earth
NORAD	North American Air Defense Command
op	operation
OP	observation post
OPCON	operational control
OPLAN	operation plan
OPORD	operation order
org	organization

PAR pulse acquisition radar

PCP platoon command post

PGM precision-guided munition

PIVADS product improvement Vulcan air defense system

plt platoon

POL petroleum, oils, and lubricants

PTL primary target line

pub publication

PWRMS pre-positioned war reserve materiel stock

R reinforcing

RADC region air defense commander

rd round

RFDL radio frequency data link

RIE radar interface equipment

ROA restricted operation area

ROE rules of engagement

ROR range only radar

rpm revolutions per minute

RPV remotely piloted vehicle

RRA refitted, retired aircraft

RS radar set

S2 Intelligence Officer (US Army)

S3 Operations and Training Officer (US Army)

SAM surface-to-air missile

sec second

SHORAD short-range air defense

SHORADEZ short-range air defense engagement zone

SLF selective identification feature

sig signal

SL squad leader

SOA state of alert

SOC sector operations center

SOJ standoff jammer

SOR state of readiness

SP self-propelled

STAMO stable master oscillator

SYSCON systems control

TAADCOM Theater Army Air Defense Command

tac tactical

TACC tactical air control center

TBM tactical ballistic missile

TCO tactical control officer

TOC tactical operations center

TVM track via missile

unk unknown

US United States

VHF very high frequency

w with

WAD weapon alert designator

WCC weapons control computer

WCS weapon control status

WEZ weapon engagement zone

w/o without